Document Control Number
TZ1-C02016-RS-01059

Interim Remedy for Contaminated Groundwater at the CPS Chemical/Madison Industries Site Old Bridge Township, Middlesex County, New Jersey

Appendices

Submitted to:

U.S. Environmental Protection Agency
Region II
26 Federal Plaza
New York, New York 10278

June 8, 1990

382832

EPA Contract No. 68-W9-0002, WA# C02016

Project No. 1-853-03-200-00

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APPENDIX A-1

TIMELINE

APPENDIX A-1 TIMELINE

Legal actions are represented by light shading

Pre-1967	No "serious problems" with groundwater contamination collected during routine sampling (Ad-Tek pps. 5-6).
1967	CPS Chemicals and Madison Industries (formerly Food Additives) begin plant operations.
5/1970	NJDEP finds high levels of Zn during routine analysis of groundwater samples taken from Perth Amboy's well field.
12/1970 - 9/1970	NJDEP finds Zn at increasing concentrations in Bennet Suction Line (BSL) wells.
1971	City of Perth Amboy finds Zn in BSL wells during routine sampling.
1-3/1971	NJDEP samples surface water (puddles and riverlets) within Madison facility and detects chlorides, sulfates, and nine heavy metals. Zn, Pb, and Cd are detected at high concentrations.
3/1971	State orders Perth Amboy to stop pumping BSL wells (#1-6) as a result of contamination from "chlorides, Zn, and other heavy metals" (Ad-Tek p. 21).
2-4/1973	NJDEP determines that pollutants, originating from Madison Industries, are contaminating the well field via Pricketts Brook.
3-4/1973	Schoor Engineering, on behalf of Sayreville Water Department, detects Cd, Pb, and Zn in groundwater samples, and Cd and Pb in surface-water sample, in excess of New Jersey drinking water standards. Schoor concludes that Pricketts Brook contamination is from stormwater runoff from Madison Industries.

APPENDIX A-1 TIMELINE (continued)

3/9/1973	State orders shutdown of remaining service wells (BSL wells #7-32) as a result of contamination from "chlorides, Zn, Pb, Mn, and possibly other deleterious substances" (Ad-Tek p. 21).
5/16/1973	NJDEP (Joseph Mikulka) compiles data on surface waters in Tennent Pond and Pricketts Brook, and discovers increased concentrations of Pb, Zn, and Fe compared to previous studies.
1973	TV inspection of the Madison Township Sewer Authority (MTSA) industrial trunk sewer reveals a broken lateral connection in the sewer line. MTSA instructed Madison Industries to install a pretreatment device to reduce the highly acidic effluent being discharged into the main sewer line. The sewer leak is suspected as a main source of contamination from the Madison Industries site.
5/31/1973	NJDEP orders Madison Industries to cease the discharge of improperly treated industrial wastewaters to Pricketts Brook (by 1975 Madison Industries still had not complied).
1973	Pricketts Pond constructed.
6-9/1973	NJDEP samples surface water from Pricketts Brook and finds high concentrations of Zn and Fe downgradient of the Madison property.
1973	Madison/CPS site is paved, potentially reducing the direct discharge to the soil, but increasing stormwater runoff.
9/1974	Citizens complain of acid fumes.
1974-1975	Ad-Tek samples surface water, groundwater, sediment, and soils for metals and finds high levels of Zn in groundwater samples. Ad-Tek concludes that Madison Industries is the source of metal contamination. Highest levels of Pb and Zn were detected in soil samples collected south and northwest of the Madison Industries site. Ad-Tek also suggests that Pricketts Brook sediments were contaminated by runoff from the broken sewer line.

APPENDIX A-1 TIMELINE (continued)

1/1975	Dr. Faust (on behalf of Madison Industries) samples surface water and soil in the Pricketts Brook watershed and finds a "virtual absence" of Cd, Pb, and Cr in Pricketts Brook. He concludes that there is not a hazard for the Perth Amboy water supply (Ad-Tek p.24).
1976-1978	NJDEP conducts groundwater sampling and analyses, and tests for and detects five constituents (Zn, Pb, Cd, MeCl and 1,1,2,2-tetrachlolroethane) and 32 other organics. This is the first time organics are detected in groundwater samples. SUMMARY REPORT NOT PROVIDED.
4/1976	Citizens complain of bad odor.
11/1977	CPS employees complain of acid odor and particulate fumigation. The source is believed to be Madison Industries, who would not allow a site investigation. A violation is cited to Madison.
7/1979	Madison Industries is ordered to cease the open burning of refuse, including Zn powder, which is a violation of NJ Air Pollution laws.
8/1979	Citizens complain of crop and car paint damage. A follow-up investigation reveals an accidental discharge from CPS of a mixture of methanol and water and smaller amounts of dimethyl adipate. CPS agrees to pay for damages.
1979	NJ Superior Court issues a court order to investigate and determine the feasibility of removing contaminated groundwater and soil.
1980	The court commissions Dames & Moore (D&M) to address the court order. D&M proposes the following: a slurry cutoff wall encompassing the CPS/Madison properties to isolate contaminated groundwater; rerouting of Pricketts Brook; and dredging of Pricketts Pond.
1980	D&M samples for the 5 constituents and finds Pb and Cd in groundwater samples. D&M also finds Pb in soils, the highest occurring downgradient of Madison Industries.

APPENDIX A-1 TIMELINE (continued)

6/1981	NJ Superior Court files an order mandating implementation of remediation plan based on D&M's evaluation
10/1981	NJ Superior Court judgment finds CPS and Madison Industries guilty of polluting the groundwater and awarded the State and the City of Perth Amboy $5.2 million for a remedial and contamination plan.
~1981	CPS/Madison appeal to the Court.
1982	Converse Consultants, on behalf of Madison Industries, determines that the proposed confining soil layer (South Amboy Fire Clay) to be used in conjunction with the slurry wall is discontinuous. Converse consultants suggests that a partial slurry wall would be more cost-effective.
3/1982	Princeton Aqua Science (PAS), on behalf of NJDEP, conducts groundwater sampling and tests for Zn, Pb, Cd, and Cu. SUMMARY REPORT NOT PROVIDED.
5/1982	CPS/Madison site is listed on Superfund National Priorities List (NPL).
8/1982	Site investigation (SI) is conducted under the authority of CERCLA. Activities at the site include midnight dumping and repeated spills. The SI also mentions that site operators are under at least 50 criminal indictments for illegally dumping hazardous wastes into the sanitary sewer. Appellate court affirms the 1981 judgment and remands it to the Trial Court for an amended judgment.
5/1983	Wehran Engineering, on behalf of CPS, indicates that the South Amboy Fire Clay (uppermost clay unit); is discontinuous. However, the deeper Woodbridge Clay is continuous and could be an effective confining layer for the court's original proposed perimeter cutoff wall. Wehran suggests the installaton of a crescent-shaped slurry wall downgradient and above the head of Pricketts Pond.

APPENDIX A-1 TIMELINE (continued)

5/23/1983	Converse, on behalf of Madison, concludes that Madison is the source of heavy metals contamination; however, the level of contamination is lower than previously reported. Converse also recommends a cost-effective remedial plan, including the following: installation of an impervious slurry wall and an inceptor well, in accordance with the Wehran plan; installation of a discharge line to the MTSA line and 8 to 10 monitoring wells; backfill of Pricketts Pond upstream of the slurry wall; and diversion of Pricketts Brook.
5/1983-3/1984	Wehran provides amendments to their proposed remedial action plan.
6/1983	Trail Court amends the 1981 order. The proposed remedial action is modified. The Appellate Court upheld the Superior Court decision and modified it by lifting cost cap and making companies jointly and severally liable. The NJDEP begins reviewing the proposed modification to the remedial action.
1983	CPS is indicted on charge of disposing of hazardous wastes by dumping them into the Old Bridge sewer system (Star-Ledger 1984).
9/1983	PAS, on behalf of NJDEP, finds that either the influent (into the Middlesex County Utilities Authority treatment system) should be diluted, or the groundwater should be pretreated to remove primary pollutant metals (Zn, Pb, Cu) and purgeable organics.
1984	CPS is suspected of tampering with monitoring wells (Star-Ledger 1984).
4/1984	Converse & Wehran (on behalf of Madison and CPS) sample for metals and VOCs detected in pond sediments and indicate that the extent of contamination is much less than determined by Ad-Tek and D&M.
4/17/1984	HydroQual suggests that conclusions presented in the 1983 PAS report are in error and do not adequately address the purpose of the investigation.
6/20/1984	NJDEP conducts surface-water sampling in Pricketts Brook and tests for Zn, Pb, Cd, Cu, and halogenated and aromatic volatiles. SUMMARY REPORT NOT PROVIDED.

APPENDIX A-1 TIMELINE (continued)

8/1984	CH2M Hill, on behalf of NJDEP, proposes expansion of the slurry wall to the south and southwest to enclose the entire area of known contamination (which extended to the northern portion of Pricketts Pond), eliminating the need for decontamination wells outside of the wall.
9-11/1984	NJDEP determines that the modified remedial action plan proposed by Wehran & Converse is adequate.
9/1985	NJ Supreme Court approves modified remedial action plan. The proposed modified remedial plan returns to Middlesex County Superior Court due to the City of Perth Amboy's objections.
5/1986	To determine the feasibility of implementing the court order, Wehran submits a report evaluating the extent of the South Amboy Fire Clay at the CPS/Madison site.
4/9/1987	Additional analytical results for VOCs and metals in groundwater are presented by Wehran.
6/24/1987	As requested by the NJ Superior Court, Richard Olsson investigates the occurrence of the South Amboy Fire Clay and finds that it is too thin and discontinuous to serve as a confining unit for the containment wall.
4/1988	Final court order requires implementing a remedial plan that includes the following: a slurry wall in conjunction with a groundwater recovery system, as proposed by Wehran (3/28/84); relocation of the Pricketts Brook, as proposed by Converse (5/27/83); and discharge of the recovered groundwater to the sewage treatment plant.
11/1988	Wehran installs 13 "DW" wells and conducts groundwater sampling for Zn, Cu, Pb, Cd, and VOCs. Wehran finds that metals (especially Zn) are present with the highest concentrations contained on the Madison property and volatiles are still present in the groundwater.

11/1/1988	CDM prepares a draft completeness review of documents containing information and data on the CPS/Madison site.
4/1989	Wehran prepares a report analyzing sampling results from 1988. Wehran recommends that further groundwater sampling be conducted to confirm results of existing data. The additional groundwater sampling data can be used to predict an effective location of the recovery wells through computer models. Wehran also recommends that additional data concerning the Evor Phillips Site and other potential sources of contamination be evaluated to determine the impact on the CPS/Madison remediation program. The Wehran (1989) report showed that the full extent of the contamination has not been determined. All of the contaminated groundwater is not discharging in the Pricketts Pond. Thus, additional plume delineation is necessary and the remediation system will have to be redesigned.

APPENDIX A-2

GROUNDWATER ANALYSES FOR FIVE SELECTED CONSTITUENTS

GROUNDWATER CONTAMINATION OF FIVE CONSTITUENTS

					Zinc																						
SOURCE:	WEH,89	WEH,87	NJDEP,85	CON,83	PAS,82	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	DM,80	AT,75	DM,80	DM,80	DM,80	DM,80
SAMPLER:							NJDEP	NJDEP	NJDEP	NJDEP	NJDEP	NJDEP	NJDEP	NJDEP	NJDEP	NJDEP	NJDEP	NJDEP	NJDEP	NJDEP	NJDEP	NJDEP		NJDEP	NJDEP	NJDEP	NJDEP
DATE:	11/88	3/87	5/85	5/83	3/82	10/79	10/77	9/12/	9/6/	8/77	5/77	8/76	6/76	5/76	4/76	11/75	10/75	9/24/	9/13/	8/75	6/75	5/75	12/74	2/74	5/73	4/73	3/73
WELLS:																		75	75								
M-1		18.27		42	25	31		625			500	75				6.34	6.71	108	130	100							
M-2	269	14.51		36	779	470	1660	1125			525	1150				6.5	6.77	3560	3570	1245							
M-3				0.22		2.3	1.7	3.5	2.475		0.725	1				5.8	0.88	27.25	4.75	0.95							
M-4		0.244		0.08			0.202	0.275			0.45	0.35				3.73		1.6	6	36.25							
M-5		0.796		1.2			0.115	0.15			0.1	0.325				0.85	0.45	1.11	0.8	4.2							
M-6	3.41	5.225		17																							
S-1						0.36	1.3	0.45	0.5	97.7																	
S-2							0.798	0.8	0.625	0.328																	
S-3							2.305	3.1	1.225	1.55																	
A		18.21	10.85	22	4.83	64	179	218	155												515	?	7.8				
B		0.32	9.09	45		27	0.232	0.275	0.199							2.07	0.44	0.46			0.45	0.66	< 0.02				
C					0.216				1.275							0.3					3.25		< 0.02				
D						6.3	12.2	12.5	12.5							6.17		19.75			1.05	20.05	8.2				
E						0.22	0.274	0.2	0.167			0.425			0.4	1.87	0.28	1.15			0.65	7.44	< 0.02				
F							0.943	0.275	0.217			0.65			0.85	0.49		2.6			1.4	0.96	< 0.02				
G							0.485	0.6	0.214		0.375	1.05			0.8	3.45	0.87	2.1			0.35	0.93	< 0.02				
H											0.7	0.5			0.55	0.43	0.51	0.49			0.75	1.12	< 0.02				
No.1													ND								1.6	2.4	1.7				
No.2							0.465						ND														
No.3			6.625										ND									4.96	5.3	78.75			
No.4													2.7	0.36	5.3								1.4				
No.5													ND		0.01												
No.6																											
No.7																											
No.8																											
No.9																											
No.10			8.125	13	0.962																						
No.11					1.25																		< 0.02				
No.12				97	156																						
No.13																							< 0.02				
No.14																											
No.15																											
No.16					0.404										1.2												
No.17																											
No.18																											
No.19					0.562																						
No.20																											
No.21																											
No.22																											
WCC-1M	0.428				0.586																						
WCC-1D	0.635				0.423																						
WCC-2	1.31																										
WCC-2M					0.428																						
WCC-3S																											
WCC-3M	0.424				0.447																						
WCC-3D	0.403				0.351																						
WCC-4S					0.950																						
WCC-4M					3.82																						
WCC-4D																											
WCC-5S					0.288																						
WCC-6S	0.82				0.486																						
WCC-6M	0.259				1.18																						
WCC-6D					1.04																						
WCC-7M					1.61																						
WCC-9S		5.415		1.8	3.44																						
WCC-9M		1.988		3.9																							

Zinc

SOURCE:	SAMPLER:	WEH,89	WEH,87	NJDEP,85	CON,83	PAS,82	DM,80	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	AT,75	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP
DATE:		11/88	3/87	5/85	5/83	3/82	10/79	10/77	9/12/	9/6/	8/77	5/77	8/76	6/76	5/76	4/76	11/75	10/75	9/24/ 75	9/13/ 75	8/75	6/75	5/75	12/74	2/74	5/73	4/73	3/73
WELLS:																												
WCC-11S		6.97	9.33		110	20.9																						
WCC-11	M	16.4	0.662		0.39	15.6																						
WCC-11D			0.998			5.5																						
WCC-12	M	0.021			0.13	0.892																						
WCC-13	M	0.174			0.18																							
WCC-14S					0.8	0.161																						
WCC-15S	E				0.03	0.216																						
WCC-15	M/W				0.75																							
WCC-15D						0.149																						
WCC-16S		7.1			0.17	0.51																						
SCHOOR:																												
SE-1																												
SE-2																												
SE-3																												
SE-4																												
LAYNE:																												
L-1																												
L-1A																												
L-2																										ND	ND	0.025
L-3																												
L-4																									1.175	15	0.25	0.3
L-5																									0.22		0.15	0.2
WEHRAN:																												
WE-1																												
WE-2																												
WE-3																												
WE-4																												
T-1			28.54	289.6	210																							
T-2																												
DEP-1		0.378																										
DEP-2		0.354																										
DEP-3																												
DEP-4		7.66																										
DW-1S		0.903																										
DW-1D		0.095																										
DW-2S		0.659																										
DW-3S		0.521																										
DW-3D		0.088																										
DW-4S		1.09																										
DW-4D		0.207																										
DW-5S		2.14																										
DW-5D		0.047																										
DW-6S		0.945																										
DW-6D		0.151																										
DW-7S		0.108																										
DW-7D		0.065																										
Say-Pro A				0.101																								
FB-1		0.047	0.151																									
FB-2	<	0.026																										
FB-3	<	0.026																										
FB-4																												
TB-1			0.051																									
TB-2																												
TB-3																												
TB-4																												
MB																												

GROUNDWATER CONTAMINATION OF FIVE CONSTITUENTS (Continued)

SOURCE: SAMPLE DATE:	WEH,89 11/88	WEH,87 3/87	NJDEP,85 5/85	CON,83 5/83	Lead PAS,82 3/82	DM,80 10/79	DM,80 NJDEP 10/77	DM,80 NJDEP 9/12/	DM,80 NJDEP 9/6/	DM,80 NJDEP 8/77	DM,80 NJDEP 5/77	DM,80 NJDEP 8/76	DM,80 NJDEP 6/76	DM,80 NJDEP 5/76	DM,80 NJDEP 4/76	DM,80 NJDEP 11/75	DM,80 NJDEP 10/75	DM,80 NJDEP 9/24/75	DM,80 NJDEP 9/13/75	DM,80 NJDEP 8/75	DM,80 NJDEP 6/75	DM,80 NJDEP 5/75	AT,75 12/74	DM,80 NJDEP 2/74	DM,80 NJDEP 5/73	DM,80 NJDEP 4/73	DM,80 NJDEP 3/73
WELLS:																											
M-1		0.322		0.2	0.316	0.16		0.8			0.555	0.01			0.003	0.017	0.002	0.042	0.005	0.043							
M-2	0.376	0.948		< 0.1	0.442	0.27	0.014	0.001			0.019	0.008			0.024	0.088	0.041	0.015	0.034	0.062							
M-3				< 0.2		0.2	0.076	0.001	0.051		0.007	0.013			0.003	0.003	0.004	0.004	0.003	0.003							
M-4		0.005		< 0.1			ND	0.003			0.007	0.016			0.015	ND		0.001	0.005	ND							
M-5		0.474		< 0.1			ND	0.003			0.009	0.024			0.017	0.003	0.004	0.002	0.004	0.008							
M-6	0.014	0.005		< 0.1																							
S-1						0.36	0.008	0.004	ND	0.062																	
S-2							0.026	0.009	0.051	0.328																	
S-3							0.11	0.016	0.088	0.092																	
A		0.005	0.025	< 0.1	0.027	< 0.03	0.052	0.037	0.034												0.023		< 0.005				
B		0.018	0.005	< 0.1		< 0.03	ND	ND	ND							0.005	0.004	0.003			0.009	0.009	< 0.005				
C					0.02				0.117							0.003					0.006		< 0.005				
D						< 0.03	0.008	0.013	0.017							0.023		0.015			0.008	0.082	< 0.005				
E						0.05	0.008	0.009	0.018			0.09			18.4	ND	0.004	0.003			0.008	0.023	< 0.005				
F							0.008	ND	0.009			0.019			0.016	0.069		0.035			0.005	0.016	< 0.005				
G							0.008	0.001	0.015		0.013	0.07			0.004	0.006	0.004	0.005			0.005	0.006	< 0.005				
H											0.01	0.047			0.027	0.101	0.011	0.008			0.014	0.103	< 0.005				
No.1													ND								0.006	0.014	< 0.005				
No.2													ND														
No.3			0.041				0.008						ND									0.003	< 0.005	0.004			
No.4													ND	0.002	0.003								< 0.005				
No.5													0.002		0.003												
No.6																											
No.7																											
No.8																											
No.9																											
No.10			0.063	0.2	0.342																						
No.11					0.034																		< 0.005				
No.12				0.2	6.92										0.002												
No.13																							< 0.005				
No.14																											
No.15																											
No.16					< 0.017										0.003												
No.17																											
No.18																											
No.19					0.024																						
No.20																											
No.21																											
No.22																											
WCC-1M	0.013				0.03																						
WCC-1D	• 0.0014				0.074																						
WCC-2	< 0.091																										
WCC-2M					0.051																						
WCC-3S																											
WCC-3M	< 0.091				0.04																						
WCC-3D	• 0.003				0.071																						
WCC-4S					0.03																						
WCC-4M					0.203																						
WCC-4D																											
WCC-5S					< 0.017																						
WCC-6S	• 0.0014				0.022																						
WCC-6M	0.0078				0.074																						
WCC-6D					0.206																						
WCC-7M					0.03																						
WCC-9S		0.005		< 0.1	0.071																						
WCC-9M		0.005		< 0.1																							
WCC-9D					0.04																						

GROUNDWATER CONTAMINATION OF FIVE CONSTITUENTS (Continued)

Lead

SOURCE: SAMPLE DATE: WELLS:	WEH,89 11/88	WEH,87 3/87	NJDEP,85 5/85	CON,83 5/83	PAS,82 3/82	DM,80 10/79	DM,80 NJDEP 10/77	DM,80 NJDEP 9/12/	DM,80 NJDEP 9/6/	DM,80 NJDEP 8/77	DM,80 NJDEP 5/77	DM,80 NJDEP 8/76	DM,80 NJDEP 6/76	DM,80 NJDEP 5/76	DM,80 NJDEP 4/76	DM,80 NJDEP 11/75	DM,80 NJDEP 10/75	DM,80 NJDEP 9/24/ 75	DM,80 NJDEP 9/13/ 75	DM,80 NJDEP 8/75	DM,80 NJDEP 6/75	DM,80 NJDEP 5/75	AT,75 12/74	DM,80 NJDEP 2/74	DM,80 NJDEP 5/73	DM,80 NJDEP 4/73	DM,80 NJDEP 3/73
WCC-11S	• 0.0025	0.028		< 0.1	0.061																						
WCC-11	• 0.0038	0.005		< 0.1	0.105																						
WCC-11D		0.005			0.098																						
WCC-12	• 0.0039			< 0.1	0.054																						
WCC-13	• 0.0032			< 0.1	0.071																						
WCC-14S				< 0.1	0.071																						
WCC-15S				< 0.1	0.078																						
WCC-15				< 0.1																							
WCC-15D					0.071																						
WCC-16S	• 0.0028			< 0.1	0.084																						
SCHOOR:																											
SE-1																											
SE-2																											
SE-3																											
SE-4																											
LAYNE:																											
L-1																											
L-1A																											
L-2																									ND	0.001	0.01
L-3																											
L-4																								0.006	ND	0.005	0.007
L-5																								0.004	0.005	0.004	0.011
WEHRAN																											
WE-1																											
WE-2																											
WE-3																											
WE-4																											
T-1		0.005	0.375	0.2																							
T-2																											
DEP-1	• 0.002																										
DEP-2	• 0.0011																										
DEP-3																											
DEP-4	0.007																										
DW-1S	< 0.00091																										
DW-1D	< 0.00091																										
DW-2S	< 0.00091																										
DW-3S	< 0.00091																										
DW-3D	< 0.00091																										
DW-4S	< 0.00091																										
DW-4D	< 0.00091																										
DW-5S	< 0.00091																										
DW-5D	< 0.00091																										
DW-6S	• 0.00098																										
DW-6D	0.0055																										
DW-7S	< 0.00091																										
DW-7D	< 0.00091																										
Say-Pro A			0.006																								
FB-1	• 0.0012	0.025																									
FB-2	< 0.00091																										
FB-3	• 0.0032																										
FB-4																											
TB-1		0.043																									
TB-2																											
TB-3																											
TB-4																											
MB																											

GROUNDWATER CONTAMINATION OF FIVE CONSTITUENTS (Continued)

Cadmium

SOURCE:	WEH,89	WEH,87	NJDEP,85	CON,83	PAS,82	DM,80	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	AT,75	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP
SAMPLE DATE:	11/88	3/87	5/85	5/83	3/82	10/79	10/77	9/12/75	9/6/75	8/77	5/77	8/76	6/76	5/76	4/76	11/75	10/75	9/24/75	9/13/75	8/75	6/75	5/75	12/74	5/73	4/73	3/73
WELLS:																										
M-1		0.078		0.54	0.051	0.17		1.7			0.4	0.041			0.011	0.031	0.024	0.042	0.024	0.044						
M-2	1.48	0.06		< 0.02	2.01	0.07	0.3	0.065			0.028	0.058			0.031	0.039	0.08	0.061	0.09	0.09						
M-3				< 0.04		< 0.01	0.002	0.008	0.007		0.002	ND			0.041	0.002	0.003	0.004	0.003	0.01						
M-4		0.005		< 0.02			ND	ND			ND	ND			0.005	0.001		0.002	0.007	0.016						
M-5		0.005		< 0.02			ND	ND			ND	ND			0.005	0.002	0.004	0.003	0.003	0.012						
M-6	0.023	0.015		0.13																						
S-1						< 0.01	ND	0.003	0.001	0.01																
S-2							0.004	0.006	0.003	0.002																
S-3							0.007	0.007	0.005	0.009																
A		0.005	0.025	< 0.02	< 0.003	< 0.01	0.032	0.041	0.039												0.006		< 0.001			
B		0.005	0.001	< 0.02		< 0.01	ND	0.003	ND							0.001	0.002	0.004			ND	0.011	< 0.001			
C					< 0.003				ND							0.002					0.006		< 0.001			
D						< 0.01	0.013	0.011	0.011							0.013		0.015			ND	0.025	< 0.001			
E						< 0.01	0.002	0.003	ND			0.001			0.002	0.002	0.004	0.02			ND	0.026	< 0.001			
F							0.003	0.006	ND			ND			0.001	0.003		0.04			0.007	0.013	< 0.001			
G							0.003	0.005	0.002		0.002	ND			0.002	0.001	0.003	0.04			0.003	0.017	< 0.001			
H											0.002	0.001			0.002	0.001	0.003	0.005			0.002	0.002	< 0.001			
No.1													ND								0.01	0.017	< 0.001			
No.2													ND													
No.3			0.017				0.002						ND									0.031	< 0.001			
No.4													ND	0.001	0.003								< 0.001			
No.5													0.003		0.07											
No.6																										
No.7																										
No.8																										
No.9																										
No.10			0.001	< 0.02	< 0.003																					
No.11					< 0.003																		< 0.001			
No.12				< 0.02	0.126										0.003											
No.13																							< 0.001			
No.14																										
No.15																										
No.16					< 0.003										0.021											
No.17																										
No.18																										
No.19					< 0.003																					
No.20																										
No.21																										
No.22																										
WCC-1M	< 0.0043				< 0.003																					
WCC-1D	< 0.0043				0.006																					
WCC-2	< 0.0043																									
WCC-2M					0.021																					
WCC-3S																										
WCC-3M	< 0.0043				0.009																					
WCC-3D	< 0.0043				< 0.003																					
WCC-4S					0.008																					
WCC-4M					0.007																					
WCC-4D																										
WCC-5S					< 0.003																					
WCC-6S	< 0.0043				0.006																					
WCC-6M	< 0.0043				0.034																					
WCC-6D					0.012																					
WCC-7M					0.019																					
WCC-9S		0.005		< 0.02	0.006																					
WCC-9M		0.005		< 0.02																						
WCC-9D					0.022																					

GROUNDWATER CONTAMINATION OF FIVE CONSTITUENTS (Continued)

Cadmium

SOURCE:	WEH,89	WEH,87	NJDEP,85	CON,83	PAS,82	DM,80	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	AT,75	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP
SAMPLE DATE:	11/88	3/87	5/85	5/83	3/82	10/79	10/77	9/12/75	9/6/75	8/77	5/77	8/76	6/76	5/76	4/76	11/75	10/75	9/24/75	9/13/75	8/75	6/75	5/75	12/74	5/73	4/73	3/73
WELLS:																										
WCC-11S	< 0.0043	0.005		< 0.02	0.004																					
WCC-11	< 0.0043	0.005		< 0.02	< 0.003																					
WCC-11D		0.005			0.011																					
WCC-12	< 0.0043			< 0.02	0.004																					
WCC-13	< 0.0043			< 0.02																						
WCC-14S				< 0.02	0.011																					
WCC-15S				< 0.02	0.004																					
WCC-15				< 0.02																						
WCC-15D					0.009																					
WCC-16S	< 0.0043			< 0.02	0.003																					
SCHOOR:																										
SE-1																										
SE-2																										
SE-3																										
SE-4																										
LAYNE:																										
L-1																										
L-1A																										
L-2																										
L-3																								ND	ND	ND
L-4																										
L-5																								0.002	ND	0.001
WEHRAN																								ND	ND	0.002
WE-1																										
WE-2																										
WE-3																										
WE-4																										
T-1		1.694	0.012	0.97																						
T-2																										
DEP-1	< 0.0043																									
DEP-2	< 0.0043																									
DEP-3																										
DEP-4	0.017																									
DW-1S	< 0.0043																									
DW-1D	< 0.0043																									
DW-2S	< 0.0043																									
DW-3S	< 0.0043																									
DW-3D	< 0.0043																									
DW-4S	< 0.0043																									
DW-4D	< 0.0043																									
DW-5S	< 0.0043																									
DW-5D	< 0.0043																									
DW-6S	< 0.0043																									
DW-6D	< 0.0043																									
DW-7S	< 0.0043																									
DW-7D	< 0.0043																									
Say-Pro A			0.001																							
FB-1	< 0.0043	0.005																								
FB-2	< 0.0043																									
FB-3	< 0.0043																									
FB-4																										
TB-1		0.005																								
TB-2																										
TB-3																										
TB-4																										
MB																										

SOURCE:	WEH,89	WEH,87	NJDEP,85	CON,83	PAS,82	DM,80	DM,80 NJDEP	DM,80 FAUST	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	AT,75
SAMPLE DATE:	11/88	3/87	5/85	5/83	3/82	10/79	12/78	10/78	7/78	10/77	9/12/75	9/6/75	8/77	4/76	12/74
WELLS:	Methylene chloride														
M-1					ND	< 0.01	0.073			ND	ND			< 0.0001	
M-2	0.016				ND	0.16	0.053				ND			< 0.0001	
M-3		ND				83	2.6			4.3	16.1			0.12	
M-4							< 0.0008			ND	ND			< 0.0001	
M-5							0.0012			ND	ND			< 0.0001	
M-6	0.43														
S-1						67	10.3			1.9	0.85	ND	8.5		
S-2							< 0.0008			ND	ND	ND	ND		
S-3							0.0024			ND	ND	ND	ND		
A						0.01		0.0482							
B			1.4			18.7	103	391	102	1.7	5.2	12			
C									0.0048			ND			
D						< 0.01	< 0.0005		0.0004	ND	ND	ND			
E						0.017	< 0.0005		< 0.0004	ND	ND	ND		< 0.0001	
F										ND	ND	ND		< 0.0001	
G							< 0.0005		< 0.0004	ND	ND	ND		< 0.0001	
H														< 0.0001	
No.1								0.257							
No.2															
No.3							< 0.0005	0.0046	0.042						
No.4								0.0017							
No.5							< 0.0008	0.0072		ND					
No.6															
No.7															
No.8															
No.9															
No.10					ND			1.23							
No.11					0.0024			21.33							
No.12			1.2		17										
No.13															
No.14															
No.15															
No.16					ND			0.014	0.013						
No.17															
No.18								0.0027							
No.19					ND										
No.20															
No.21															
No.22															
WCC-1M	< 0.01	ND			ND										
WCC-1D	< 0.01	ND			ND										
WCC-2	< 0.01														
WCC-2M					ND										
WCC-3S															
WCC-3M	< 0.01				ND										
WCC-3D	< 0.01				ND										
WCC-4S					ND										
WCC-4M					ND										
WCC-4D															
WCC-5S					ND										
WCC-6S	< 0.01	ND			3.845										
WCC-6M	< 0.01	ND			ND										
WCC-6D		ND			ND										
WCC-7M					0.0098										
WCC-9S		ND			ND										
WCC-9M		0.68													
WCC-9D					0.218										

SOURCE:	WEH,89	WEH,87	NJDEP,85	CON,83	PAS,82	DM,80	DM,80 NJDEP	DM,80 FAUST	DM,80 NJDEP	AT,75
SAMPLE DATE:	11/88	3/87	5/85	5/83	3/82	10/79	12/78	10/78	7/78	12/74
WELLS:	1,1,2,2-tetrachloroethane									
M-1					ND	0.01	0.0011			
M-2	< 0.01				ND	0.054	< 0.0005			
M-3		ND				4.51	0.24			
M-4							0.0013			
M-5							< 0.0007			
M-6	< 0.01									
S-1						8.43	8			
S-2							< 0.0007			
S-3							< 0.0007			
A		ND			ND	< 0.01	0.0007	0.0137		
B		ND	0.049			3.3	8.4	3.853	1.43	
C		ND			ND				< 0.0004	
D						< 0.01	0.0004		< 0.0004	
E						< 0.01	0.0016		< 0.0004	
F							< 0.0004			
G							< 0.0005		< 0.0004	
H										
No.1							0.0033			
No.2										
No.3							< 0.0005		< 0.0004	
No.4										
No.5							< 0.0007			
No.6										
No.7										
No.8										
No.9										
No.10					ND					
No.11					ND			1.677		
No.12			0.094		ND					
No.13										
No.14										
No.15										
No.16					ND		< 0.0004			
No.17										
No.18										
No.19					ND					
No.20										
No.21										
No.22										
WCC-1M	< 0.01	0.011			ND					
WCC-1D	< 0.01	ND			ND					
WCC-2	< 0.01									
WCC-2M					ND					
WCC-3S										
WCC-3M	< 0.01				ND					
WCC-3D	< 0.01				ND					
WCC-4S					ND					
WCC-4M					ND					
WCC-4D										
WCC-5S					ND					
WCC-6S	< 0.01	ND			ND					
WCC-6M	< 0.01	ND			ND					
WCC-6D		ND			ND					
WCC-7M					ND					
WCC-9S		ND			ND					
WCC-9M		ND								
WCC-9D					ND					

Methylene chloride

SOURCE:	WEH,89	WEH,87	NJDEP,85	CON,83	PAS,82	DM,80	DM,80 NJDEP	DM,80 FAUST	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	DM,80 NJDEP	AT,75
SAMPLE DATE:	11/88	3/87	5/85	5/83	3/82	10/79	12/78	10/78	7/78	10/77	9/12/75	9/6/75	8/77	4/76	12/74
WELLS:															
WCC-11S	< 0.01	ND			ND										
WCC-11	< 0.01				ND										
WCC-11D					ND										
WCC-12	< 0.01	0.96			ND										
WCC-13	< 0.01	ND													
WCC-14S					ND										
WCC-15S		ND	18		0.034										
WCC-15		ND													
WCC-15D					0.0267										
WCC-16S	< 0.01	ND			0.0079										
SCHOOR:															
SE-1															
SE-2															
SE-3															
SE-4															
LAYNE:															
L-1															
L-1A															
L-2															
L-3															
L-4															
L-5															
WEHRAN															
WE-1															
WE-2															
WE-3															
WE-4															
T-1		0.14	0.069												
T-2															
DEP-1	< 0.01	0.002													
DEP-2	< 0.01	0.059													
DEP-3		ND													
DEP-4	< 0.01														
DW-1S	< 0.01														
DW-1D	< 0.01														
DW-2S	< 0.01														
DW-3S	< 0.01														
DW-3D	< 0.01														
DW-4S	< 0.01														
DW-4D	< 0.01														
DW-5S	< 0.01														
DW-5D	< 0.01														
DW-6S	< 0.01														
DW-6D	< 0.01														
DW-7S	< 0.01														
DW-7D	< 0.01														
Say-Pro A															
FB-1	< 0.01	ND													
FB-2	< 0.01	ND													
FB-3	< 0.01	ND													
FB-4		ND													
TB-1	< 0.01														
TB-2	0.026														
TB-3	< 0.01														
TB-4															
MB		0.002			3.1										

1,1,2,2-tetrachloroethane

SOURCE:	WEH,89	WEH,87	NJDEP,85	CON,83	PAS,82	DM,80	DM,80 NJDEP	DM,80 FAUST	DM,80 NJDEP	AT,75
SAMPLE DATE:	11/88	3/87	5/85	5/83	3/82	10/79	12/78	10/78	7/78	12/74
WELLS:										
WCC-11S	< 0.01	ND			ND					
WCC-11	< 0.01				ND					
WCC-11D					ND					
WCC-12	< 0.01	ND			ND					
WCC-13	< 0.01	ND								
WCC-14S					ND					
WCC-15S		ND	0.063		ND					
WCC-15		ND								
WCC-15D					0.0203					
WCC-16S	< 0.01	0.03			ND					
SCHOOR:										
SE-1										
SE-2										
SE-3										
SE-4										
LAYNE:										
L-1										
L-1A										
L-2										
L-3										
L-4										
L-5										
WEHRAN										
WE-1										
WE-2										
WE-3										
WE-4										
T-1		ND	0.003							
T-2										
DEP-1	< 0.01	0.002								
DEP-2	< 0.01	ND								
DEP-3		ND								
DEP-4	< 0.01									
DW-1S	< 0.01									
DW-1D	0.012									
DW-2S	< 0.01									
DW-3S	< 0.01									
DW-3D	< 0.01									
DW-4S	< 0.01									
DW-4D	< 0.01									
DW-5S	< 0.01									
DW-5D	0.039									
DW-6S	< 0.01									
DW-6D	< 0.01									
DW-7S	< 0.01									
DW-7D	0.059									
Say-Pro A										
FB-1	< 0.01	ND								
FB-2	< 0.01	ND								
FB-3	< 0.01	ND								
FB-4		ND								
TB-1	< 0.01									
TB-2	< 0.01									
TB-3	< 0.01									
TB-4										
MB					ND					

GROUNDWATER CONTAMINATION OF FIVE CONSTITUENTS (Continued)

GROUNDWATER CONTAMINATION OF FIVE CONSTITUENTS (Continued)

NOTES:

- Ad-Tek lists well numbers which are assumed to be BSL wells (p.49)
- Duplicate samples were averaged
- Values are in milligrams per liter (mg/l)
- In Wehran, 1989, wells WCC-11VS and WCC-16VS are assumed to be the same as WCC-11S and WCC-16S, respectively
- Less than values from Wehran, 1989 were analyzed but not detected; the value reported is the instrument detection limit
- * = valued that is less than the detection limit required in Wehran's contract (Wehran, 1989)
- + = Avg. of Wells NO.3 and NO.3A. (The sampling of well NO.3A is treated as a replicate of well NO.3 although it was sampled the following day - NJDEP,1985)
- Say-Pro A = Sayreville Production well A

APPENDIX A-3

GROUNDWATER ORGANIC ANALYSES

ORGANICS DETECTED IN ALL WELLS (ppb)

Sampling Date: Source:	#?	3/82 PAS 3/82	5/85 NJDEP	 Wehran 4/87	11/14-16/88 Wehran 4/89
1,2-Dichloroethane					
A		6.8			
B			210	16	
DEP-1	10			22	
DW-1D					24
DW-2S					
DW-3D					
DW-3S					
DW-4D					
DW-4S					
DW-5D					13
DW-5S					
DW-6D					
DW-6S					
DW-7S					
M-1		6.5			
M-2		53			88
M-6					670
No.3			15		
No.11		12.3			
No.12		4200	770		
T-1			208		
WCC-1D		16.0			
WCC-1M	01			140	68
WCC-3M		5.8			
WCC-6D	17			28	
WCC-6S	(1)	440			
WCC-6S	(2)	54			
WCC-9D		69			
WCC-9M	03			1200	
WCC-9S	04			17	
WCC-11D		8.0			
WCC-11M					28
WCC-11M		22.6			
WCC-11S	07	15.8		12	
WCC-12M	08			1200	80
WCC-15D		24.4			
WCC-15M	13			120	
WCC-15S		106			
WCC-15S			2000		
All Others		<1		<5	

ORGANICS DETECTED IN ALL WELLS (ppb)
(Continued)

Sampling Date:	#?	3/82	5/85		11/14-16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
1,1-Dichloroethane					
A	05			640	
B			14		
M-3	20			13	
No.12		117	2		
T-1	19			400	
WCC-6S	(1)	206			
WCC-6S	(2)	10.2			
WCC-7M		16.9			
WCC-15D		4.5			
WCC-15S		1.7	22		
All Others		<1		<5	
1,1-Dichloroethene					
B			3		
No.12			3		
WCC-15S			6		
Carbon Tetrachloride					
A		9.2			
B			6.5		
No.11		6.0			
No.12		1750			
No.16		15.0			
WCC-1D		15.0			
WCC-6D	(4)	104			
WCC-6S	(1)	4480			
WCC-6S	(2)	69			
WCC-7M		17.3			
WCC-11S		25.5			
WCC-11M		11.1			
WCC-15D		60			
WCC-15S		49			
All Others		<1			

ORGANICS DETECTED IN ALL WELLS (ppb)
(Continued)

Sampling Date: Source:	#?	3/82 PAS 3/82	5/85 NJDEP	Wehran 4/87	11/14-16/88 Wehran 4/89
Bromoform					
A		18			
No.11		11.0			
No.12		2600			
WCC-6S	(1)	205			
WCC-11M		131			
WCC-11S		32			
WCC-15D		73			
WCC-15S		97			
All Others		<1			
Benzene					
A		4.5			
B	06			60	
DEP-1	10			0.6 J	
DEP-2	12			230	310
DW-5S					79
DW-7S					62
M-2		4.2			
M-3	20			22	
No.11		3.8			
No.12		655			
T-1			3		
WCC-5S		194			
WCC-6D	(4)	8.2			
WCC-6M	16			7	
WCC-6S	(2)	60			
WCC-6S	(1)	125			
WCC-11D		1.1			
WCC-11M		3.3			
WCC-11S	07	7.6		94	24
WCC-12M	8			320 J	120
WCC-15D		15.1			
WCC-15S	14	20.3		190	
All Others		<1		<5	
Toluene					
A		9.8			
B	06			29	
C				6 B	
DEP-1	10			1 JB	
DEP-2	12			850 B	980
DW-5S					63

ORGANICS DETECTED IN ALL WELLS (ppb)
(Continued)

Sampling Date:	#?	3/82	5/85		11/14-16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
DW-7D					22
MB				6	
M-2		5.7			
M-3	20			6	
No.3			18		
No.3			19		
No.11		2.5			
No.12		2130			
PA-05				7 B	
Say-Pro A			11		
TB-3				1 JB	
WCC-3M		2.0			
WCC-5S		68			
WCC-6S	(1)	795			
WCC-6S	(2)	314			
WCC-7M		124			
WCC-11M		9.1			
WCC-11S	07	5.8		7	
WCC-12M	08			3000	290
WCC-15D		45			
WCC-15M	13			5	
WCC-15S	14	42		700	
All Others		<1		<5	
Bis(2-ethylhexyl)phthalate					
MB		60			
No.19		32			
WCC-1D		36			
WCC-1M		22			
WCC-2M		43			
WCC-4M		43			
WCC-6D	(4)	27			
WCC-6S	(1)	42			
WCC-7M		37			
WCC-9D		24			
WCC-11S		175			
All Others		<20			
1,2-Dichloropropane					
A		2.2			
B			3.8		
No.11		2.9			
No.12		375	10		

ORGANICS DETECTED IN ALL WELLS (ppb)
(Continued)

Sampling Date:	#?	3/82	5/85		11/14-16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
WCC-1M		6.0			
WCC-5S		129			
WCC-6M	(3)	3.2			
WCC-6S	(1)	122			
WCC-6S	(2)	101			
WCC-7M		34			
WCC-11S		4.2			
WCC-15D		17.2			
WCC-15S		11.6	24		
All Others		<1			
Chlorobenzene					
B	06		300	110	
DEP-2	12			290	460
DW-1S					22
DW-5D					59
DW-5S					290
DW-7D					580
M-3	20			17	
No.12		26.9	300		
WCC-6S	(2)	32			
WCC-6S	(1)	115			
WCC-7M		3.8			
WCC-11S	07	4.5		65	35
WCC-12M	08			900	1100
WCC-15D		3.9			
WCC-15S	14		100	580	
All Others		<1		<5	
Trans-1,2-Dichloroethylene					
A		26.4			
B	06			110	
DEP-1	10			4 J	
DEP-2	12			46 J	
M-3	20			30	
No.11		12.0			
No.12		925			
WCC-1M	01			32	
WCC-5S		81			
WCC-6M	(3)	4.9			
WCC-6S	(2)	26.3			
WCC-6S	(1)	185			
WCC-7M		3.1			

ORGANICS DETECTED IN ALL WELLS (ppb)
(Continued)

Sampling Date: Source:	#?	3/82 PAS 3/82	5/85 NJDEP	 Wehran 4/87	11/14-16/88 Wehran 4/89
WCC-11D		2.5			
WCC-11M		23.0			
WCC-11S	07	31		24	
WCC-12M	8			1600	
WCC-15D		41			
WCC-15S		131			
All Others		<1		<5	
Ethylbenzene					
A		3.9			
B	06			22	
DEP-2	12			72 JB	87
DW-5D					10
DW-5S					26
DW-7S					40
M-2		17			
No.11		5.3			
No.12		330			
WCC-6S	(1)	60			
WCC-6S	(2)	82			
WCC-7M		5.4			
WCC-11M		6.0			
WCC-11S	07	6.4		16	
WCC-12M					50
WCC-15D		12.4			
WCC-15S	14	14.1		68	
All Others		<1		<5	
Total Xylenes					
A		9.4			
M-2		10			
No.12		1190			
WCC-6S	(1)	185			
WCC-6S	(2)	116			
WCC-7M		7.2			
WCC-11M		9.3			
WCC-11S		6.8			
WCC-15D		30			
WCC-15S		42			
All Others		<1			

ORGANICS DETECTED IN ALL WELLS (ppb)
(Continued)

Sampling Date: Source:	#?	3/82 PAS 3/82	5/85 NJDEP	Wehran 4/87	11/14-16/88 Wehran 4/89
1,1,1-Trichloroethane					
DW-6D					12
DW-6S					12
M-1		2.6			
M-2		3.7			
No.12		38			
TB-3				0.9 J	
WCC-6S	(1)	2200			
WCC-6S	(2)	56			
WCC-9D		2.7			
All Others		<1			
Trichloroethylene (Trichloroethene)					
A	05			72	
DEP-1	10			6	
DW-1D					10
DW-5D					38
DW-7S					59
M-2					14
M-2		20.3			
M-3	20			7	
M-6					80
No.11		2.3			
No.12		1230			
T-1	19			47	
WCC-1M					19
WCC-1M	01			38	
WCC-6D	17			17	
WCC-6S	(1)	524			
WCC-9D		5.3			
WCC-9M	03			190	
WCC-11M		12.9			
WCC-15M	13			17	
All Others		<1		<5	
Chrysene					
M-1		24			
WCC-6S	(2)	24			
All Others		<20			
1,3-Dichlorobenzene					
WCC-6S	(2)	21 *			
All Others		<20			

ORGANICS DETECTED IN ALL WELLS (ppb)
(Continued)

Sampling Date:	#?	3/82	5/85		11/14-16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
1,4-Dichlorobenzene					
WCC-6S	(2)	21 *			
All Others		<20			
Hexachlorobenzene					
WCC-6S	(2)	53			
All Others		<20			
Hexachlorobutadiene					
No.12		182 ***			
WCC-6S	(2)	73			
All Others		<20			
N-nitrosodiphenylamine					
No.12		208			
WCC-6S	(1)	471			
WCC-6S	(2)	24			
All Others		<20			
Benzidene					
WCC-9D		34			
All Others		<20			
Dimethylphthalate					
WCC-11S		93			
WCC-6S	(1)	26			
All Others		<20			
Bis(2-chloroethoxy)methane					
No.12		41 **			
All Others		<20			
Naphthalene					
No.12		41 **			
All Others		<20			
Nitrobenzene					
No.12		182 ***			
All Others		<20			

ORGANICS DETECTED IN ALL WELLS (ppb)
(Continued)

Sampling Date:	#?	3/82	5/85		11/14-16/88
Source:		PAS 3/82	NJDEP	Wehran 4/87	Wehran 4/89
N-nitrosodi-n-propylamine					
No.12		182 ***			
All Others		<20			
2-Chloronaphthalene					
No.12		102			
All Others		<20			
Chloroform					
DEP-1	10			4 J	
DEP-2	12			200 B	
FB-3				16	
No.3			1		
TB-1				31	
TB-3				6 B	
T-1			2		
WCC-6S	(1)	1070			
All Others		<1		<5	
Acenaphthene					
WCC-6S	(1)	23			
All Others		<20			
Acenaphthylene					
WCC-6S	(1)	46			
All Others		<20			
Hexachlorocyclopentadiene					
No.12		125			
WCC-6S	(1)	184			
All Others		<20			
Vinyl Chloride					
B	06			7 J	
DW-7S					11
WCC-11S	07			7 J	
All Others				<10	
Chloromethane					
WCC-15M	13			9 J	
All Others				<10	

ORGANICS DETECTED IN ALL WELLS (ppb)
(Continued)

Sampling Date: Source:	#?	3/82 PAS 3/82	5/85 NJDEP	Wehran 4/87	11/14-16/88 Wehran 4/89
Trichlorofluoromethane					
C				2 JB	
MB				2 J	
PA-05				3 JB	
1,2-Dichloroethene(Total)					
B			220		
DEP-2					48
DW-1D					10
DW-5D					34
DW-7S					56
No.12			500		
WCC-12M					400
WCC-15S			1600		
All Others					<10
Tetrachloroethene					
DW-5D					18
DW-7S					24
All Others					<10
Trichloroethene					
B			48		
No.12			120		
T-1			33		
WCC-15S			340		
1,3-Dichloropropene					
B			6		

Footnotes:
*, **, and *** = Compounds elute at a similar retention time.
For 4-87 Data:
< means that the compound was analyzed for but not detected at specified detection limit.
B means the analyte was found in the blanks as well as the sample. It indicates possible sample contamination and warns the data user to use caution when applying the results of this analyte.
J indicates that the compound was analyzed for and determined to be present in the sample. The mass spectrum of the compound meets the identification criteria of the method. The concentration listed is an estimated value, which is less than the specified minimum detection limit but is greater than zero.

ORGANICS DETECTED IN ALL WELLS (ppb)
(Continued)

Sampling Date: Source:	#?	3/82 PAS 3/82	5/85 NJDEP	 Wehran 4/87	11/14-16/88 Wehran 4/89

#? = Numbers not in parentheses are sample number qualifiers presented in the 4-87 data. Numbers in parentheses are sample number qualifiers presented in the 3-31-82 data. There is no indication as to what these numbers mean.

This table does not include Methylene Chloride or 1,1,2,2-Tetrachlorethane. They are inlcuded in the table of the five constituents

APPENDIX A-4

INDEX TO MAPS ON FIGURE 1-5

INDEX TO MAP UNITS IN FIGURE 1.5. (CH2M HILL 1984)

AT Atsion sand ....
BoB Boonton loam, 2 to 5 percent slopes ....
BoC Boonton loam, 5 to 10 percent slopes ....
BoD Boonton loam, 10 to 15 percent slopes ....
BUB Boonton-Urban land complex, 0 to 5 percent slopes ....
ChA Chalfont silt loam, 0 to 2 percent slopes ....
ChB Chalfont loam, 2 to 5 percent slopes ....
DnA Downer loamy sand, 2 to 5 percent slopes ....
DnC Downer loamy sand, 5 to 15 percent slopes ....
DoB Downer sandy loam, 2 to 5 percent slopes ....
DTB Downer-Urban land complex, 0 to 10 percent slopes ....
DTD Downer-Urban land complex, 10 to 15 percent slopes ....
DUA Dunellen-Urban land complex, 0 to 5 percent slopes ....
DvA Dunellen Variant sandy loam, 0 to 2 percent slopes ....
DvB Dunellen Variant sandy loam, 2 to 5 percent slopes ....
DWA Dunellen Variant-Urban land complex, 0 to 5 percent slopes....
Ek Elkton loam ....
EoA Ellington Variant sandy loam, 0 to 2 percent slopes ....
EoB Ellington Variant sandy loam, 2 to 5 percent slopes ....
ESA Ellington Variant-Urban land complex, 0 to 5 percent slopes...
EvB Evesboro sand, 0 to 5 percent slopes ....
EvC Evesboro sand, 5 to 10 percent slopes ....
EvD Evesboro sand, 10 to 15 percent slopes ....
Fa Fallsington sandy loam ....
Fb Fallsington loam ....
Fd Fallsington Variant loam ....

INDEX TO MAP UNITS IN FIGURE 1.5. (CH2M HILL 1984)

FrB	Fort Mott loamy sand, 0 to 5 percent ....
HaA	Haledon silt loam, 0 to 2 percent slopes ....
HaB	Haledon silt loam, 2 to 5 percent slopes ....
HBB	Haledon-Urban land complex, 0 to 5 percent slopes ....
HcA	Haledon Variant silt loam, 0 to 2 percent slopes ....
HeA	Hammonton loamy sand, 0 to 3 percent slopes ....
HIA	Hammonton loamy sand, clayey substratum, 0 to 3 percent slopes.
HmA	Hammonton sandy loam, 0 to 2 percent slopes ....
HoA	Holmdel fine sandy loam, 0 to 2 percent slopes ....
HU	Humaquepts, frequently flooded ....
KeA	Keyport sandy loam, 0 to 2 percent slopes ....
KeB	Keyport sandy loam, 2 to 5 percent slopes ....
KeD	Keyport sandy loam, 10 to 15 percent slopes ....
KfA	Keyport loam, 0 to 2 percent slopes ....
KfC	Keyport loam, 5 to 10 percent slopes ....
KfD	Keyport loam, 10 to 15 percent slopes ....
KGB	Keyport-Urban land complex, 0 to 10 percent slopes ....
KlA	Klej loamy sand, 0 to 3 percent slopes ....
KmA	Klej loamy sand, clayey substratum, 0 to 3 percent slopes .....
KUA	Klej clayey substratum-Urban land complex,0 to 5 percent slopes
KvB	Klinesville shaly loam, 0 to 5 percent slopes ....
KvD	Klinesville shaly loam, 5 to 15 percent slopes ....
KvE	Klinesville shaly loam, 15 to 25 percent slopes ....
KWB	Klinesville-Urban land complex, 0 to 5 percent slopes ....

INDEX TO MAP UNITS IN FIGURE 1.5. (CH2M HILL 1984)

LaA	Lakehurst sand, 0 to 3 percent slopes ....
LeB	Lakewood sand, 2 to 8 percent slopes ....
LnA	Lansdowne silt loam, 0 to 2 percent slopes ....
LnB	Lansdowne silt loam, 2 to 5 percent slopes ....
LUA	Lansdowne silt loa, 2 to 5 percent slopes ....
LvA	Lansdowne Variant silt loam, 0 to 2 percent slopes ....
Ma	Manahawkin muck ....
MeA	Matapeake silt loam, 0 to 2 percent slopes ....
MeB	Matapeake silt loam, 2 to 5 percent slopes ....
MgA	Mattapex silt loam, 0 to 2 percent slopes ....
MgB	Mattapex silt loam, 2 to 5 percent slopes ....
MoA	Mount Lucas silt loam, 0 to 2 percent slopes ....
MoB	Mount Lucas silt loam, 2 ro 5 percent slopes ....
MsB	Mount Lucas very stony silt loam, 0 to 5 percent slopes ......
Mu	Mullica sandy loam ....
NaA	Nixon loam, 0 to 2 percent slopes ....
NaB	Nixon loam, 2 to 5 percent slopes ....
NCB	Nixon-Urban land complex, 0 to 5 percent slopes ....
NfA	Nixon Variant loam, 0 to 2 percent slopes ....
NfB	Nixon Variant loam, 2 to 5 percent slopes ....
NGA	Nixon Variant-Urban land complex, 0 to 5 percent slopes ......
Pa	Parsippany silt loam ....
Pb	Parsippany silt loam, frequently flooded ....
Pc	Parsippany Variant silt loan ....

INDEX TO MAP UNITS IN FIGURE 1.5. (CH2M HILL 1984)

PeA	Pemberton loamy sand, 0 to 3 percent slopes ....
PfA	Penn silt loam, 0 to 2 percent slopes ....
PfB	Penn silt loam, 2 to 5 percent slopes ....
PhD	Phalanx loamy sand, 2 to 15 percent slopes ....
PL	Pits, clay ....
PM	Pits, sand and gravel ....
PN	Psamments, nearly level ....
PO	Psamments, sulfidic substratum ....
PW	Psamments, waste substratum ....
ReA	Reaville silt loam, 0 to 2 percent slopes ....
ReA	Reaville silt loam, 2 to 5 percent slopes ....
RFA	Reaville-Urban land complex, 0 to 5 percent slopes ....
Rh	Reaville Variant silt loam ....
Ro	Rowland silt loam ....
SaA	Sassafras sandy loam, 0 to 2 percent slopes ....
SaB	Sassafras sandy loam, 2 to 5 percent slopes ....
SaC	Sassafras sandy loam, 5 to 10 percent slopes ....
SgB	Sassafras gravelly sandy loam, 2 to 5 percent slopes ....
SgC	Sassafras gravelly sandy loam, 5 to 10 percent slopes ....
SgD	Sassafras gravelly sandy loam, 10 to 15 percent slopes ....
SIA	Sassafras loam, 0 to 2 percent slopes ....
SIB	Sassafras loam, 2 to 5 percent slopes ....
SMB	Sassafras-Urban land complex, 0 to 5 percent slopes ....
SrA	Shrewsbury sandy loam, 0 to 2 percent slopes ....

INDEX TO MAP UNITS IN FIGURE 1.5. (CH2M HILL 1984)

SU	Sulfaquents and sulfihemists, frequently flooded ....
TnB	Tinton loamy sand, 0 to 5 percent slopes ....
UB	Udorthenths, bedrock substratum ....
UC	Udorthents, clayey substratum ....
UD	Udorthents, wer substratum-Urban land complex ....
UL	Urban land ....
Wa	Watchung very stony silt loam, 0 to 2 percent slopes ....
WdA	Woodstown sandy loam, 0 to 2 percent slopes ....
WdB	Woodstown sandy loam, 2 to 5 percent slopes ....
WkA	Woodstown sandy loam, clayey substratum,0 to 2 percent slopes..
WkB	Woodstown sandy loan, clayey substratum,2 to 5 percent slopes..
WIA	Woodstown loam, 0 to 2 percent slopes ....
WIB	Woodstown loam, 2 to 5 percent slopes ....
WU	Woodstown-Urban land complex, 0 to 5 percent slopes ....

APPENDIX A-5

WELL CONSTRUCTION INFORMATION

AVAILABLE WELL CONSTRUCTION INFORMATION

Well No.	Selected?	Source of Information	Total Well Depth	Estimated Elevation of Well Bottom	Screened Unit(s)	Land Surface Elevation	Top of Casing Elevation	Top of Screen (depth)	Bottom of Screen (depth)
A	Yes	W83/AD*/DM80	51.5d/50 e	-27.14	Old Bridge		22.86 d		
B	Yes	W83/AD*/DM80	52d/47.5 e	-22.51			24.99 d		
C	NO WELL CONSTRUCTION INFORMATION								
D	Yes	W83/AD*/DM80	52d/49.0 e	-21.64	Old Bridge	27.36c	29.16 d		
E	Yes	W83/AD*/DM80	40d/40.0 e	-10.92			29.08 d		
F	Yes	AD*	58.0 e	--					
G	Yes	AD*/DM80	40.0 e	-2.18	Old Bridge	37.82c			
H	Yes	AD*/DM80	36.0 e	-9.26	Old Bridge	26.74c			
M-1		DM80/W83	44.4 c	-19.97	Old Bridge	24.43 c	23.79 d		
M-2	Yes	W83/DM80/W89	37.9 b	-14.22	Old Bridge	22.75 c	22.75d/23.68 b		
M-3		W83/DM80	45.6 c	-22.83	Old Bridge	22.77 c	22.77 d		
M-4		DM80		--					
M-5		DM80		--					
M-6	Yes	W89	48.7 b	--			-- b		
S-1	Yes	W83/DM80	30 d	-6.68	Old Bridge	23.32c	23.32 d		
S-2		DM80		--					
S-3	Yes	DM80	25 c	2.05	Old Bridge	27.05c			
WCC-1M	Yes	W83/W89	55.1 b	-27.22			27.31d/27.88 b		
WCC-1D	Yes	W86*/W89*	101.25a/98.9 b	-71.13	Raritan	26 a	26.79d/27.77 b	91	101
WCC-2M	Yes	W86*/W89*	55.75a/57.21 b	-29.01	Raritan	24 a	26.34d/28.20 b	45/46	55/56
WCC-3D	Yes	W86*/W89*	81a/80.25a/85.05 b	-55.57	Raritan	26 a	29.11d/29.48 b	71	81
WCC-3S		W83		--			27.63 d		
WCC-3M	Yes	W89	50.76 b	-22.37			28.39 b		
WCC-4M	Yes	W86*			Raritan			47	57
WCC-4D	Yes	W86*	80.16 a	-55.59		24 a	24.57 d		
WCC-4S		W83		--			24.25 d		
WCC-5M		W86*	35.75 a	-9.57	Raritan	26 a	--	25	35
WCC-5S		W83		--			26.96 d		
WCC-6D	Yes	W86*/W89*	80a/80.5 a	-54.05	Raritan	25 a	25.95 d	65	75
WCC-6S	Yes	W83/W89	37.7 b	-10.72			26.98d/26.35d/26.98 b		
WCC-6M	Yes	W83/W89	55.56 b	-29.41			26.15d/26.15 b		
WCC-7M	Yes	W86*	55.10 a	-28.74	Raritan	25 a	26.36 d	45	55

AVAILABLE WELL CONSTRUCTION INFORMATION

Well No.	Selected?	Source of Information	Total Well Depth	Estimated Elevation of Well Bottom	Screened Unit(s)	Land Surface Elevation	Top of Casing Elevation	Top of Screen (depth)	Bottom of Screen (depth)
WCC-9M	Yes	W86*	55.5a/56.50 a	-31.55	Raritan	23 a	23.95 d	45	55
WCC-9S		W83		--			24.34 d		
WCC-9D	*NO WELL CONSTRUCTION INFORMATION*								
WCC-11D	Yes	W86*/W89*	71.50 a	-48.29	Raritan	22 a	23.21 d	55	65
WCC-11S	Yes	W83/W89	20.06 b	2.83			22.89d/22.89 b		
WCC-11M	Yes	W83/W89	51.88 b	-28.63			23.25d/23.25 b		
WCC-12M	Yes	W86*/W89*	56.50a/56.50 b	-33.67	Raritan	22 a	22.83d/22.83 b	45	55
WCC-13M	Yes	W86*/W89*	56.50a/55.88 b	-34.71	Raritan	19 a	1ft stkup/21.17 b	44	54
WCC-14S		W83		--			20.39 d		
WCC-15M	Yes	W86*	51.50 a	-29.56	Raritan	21 a	21.94 d	38	48
WCC-15S		W83		--			22.02 d		
WCC-15D	*NO WELL CONSTRUCTION INFORMATION*								
WCC-16S	Yes	W83/W89	20.04 b	3.27			23.31d/23.31 b		
WE-1		W83*/W86*	25d	0.69		24a/25.69d	27.72 d	23	25
WE-2		W83*/W86*	25d	-0.29		24a/24.71d	26.93 d	23	25
WE-3		W83*	25d	2.11		27.11d	29.01 d	23	25
WE-4		W83*	25d	-0.81		24.19d	26.17 d	23	25
T-1		Con83		--					
T-2	*NO WELL CONSTRUCTION INFORMATION*								
T-3	NO WELL CONSTRUCTION INFORMATION								
No.1		DM80		--					
No.2		DM80		--					
No.3	Yes	AD*/W86*	58e	--					
No.4	Yes	AD*/W86*	38+e	--					
No.5	Yes	AD*/W86*	54e	--					
No.6	*NO WELL CONSTRUCTION INFORMATION*								
No.7	*NO WELL CONSTRUCTION INFORMATION*								
No.8	*NO WELL CONSTRUCTION INFORMATION*								
No.9		AD*/W86*	57e/57.83 a	-39		18 a			
No.10	Yes	AD*/W86*	61e/71.00 a	-46		15 a		12.98	
No.11	Yes	AD*/DM80/W86*	52e/51.75 a	-34.08	Old Bridge	17.67c/17a		14.78	
No.12		DM80		--			15.98		
No.13	Yes	AD*/DM80/W86*	50?e/60.63c/58.00 a	-40.37	Old Bridge	17.63c/17a		22c	32c

AVAILABLE WELL CONSTRUCTION INFORMATION

Well No.	Selected?	Source of Information	Total Well Depth	Estimated Elevation of Well Bottom	Screened Unit(s)	Land Surface Elevation	Top of Casing Elevation	Top of Screen (depth)	Bottom of Screen (depth)
No.14	*NO WELL CONSTRUCTION INFORMATION*								
No.15	*NO WELL CONSTRUCTION INFORMATION*								
No.16	Yes		71.7c	-53.32	S.Amboy Fire Clay	18.38c			
No.17			62.7c	-42.7	Old Bridge	20.00c			
No.18	*NO WELL CONSTRUCTION INFORMATION*								
No.19	Yes		74.0c	-54	S.Amboy Fire Clay	20.00c			
No.20	*NO WELL CONSTRUCTION INFORMATION*								
No.21	*NO WELL CONSTRUCTION INFORMATION*								
No.22	*NO WELL CONSTRUCTION INFORMATION*								
Layne #1A		DM80	>200c	>-177	Farrington	23.00c			
Layne #1		DM80		--					
Layne #2		DM80	>200c	>-180	Farrington	20.00c			
Layne #3		DM80		--					
Layne #4	Yes	DM80	70c	-50	Old Bridge	20.00c			
Layne #5		DM80		--					
Schoor #1	*NO WELL CONSTRUCTION INFORMATION*								
Schoor #2		DM80		--					
Schoor #3		DM80		--					
Schoor #4		DM80		--					
DEP-1	Yes	W89*	59.33 b	-34.67			24.66 b	50	60
DEP-2	Yes	W89*	35.25 b	-10.87			24.38 b	24.2	36.5
DEP-3	*NO WELL CONSTRUCTION INFORMATION*								
DEP-4	Yes	W89*	27.6 b	-7.81			19.79 b	20	30
DW-1S	Yes	W89*	26.15 b	-5.47			20.68 b	14.52	24.52
DW-1D	Yes	W89*	56.35 b	-35.67			20.68 b	44.63	54.63
DW-2S	Yes	W89*	26.80 b	-4.6			22.20 b	14.75	24.75
DW-3S	Yes	W89*	26.29 b	-2.32			23.97 b	14.32	24.32
DW-3D	Yes	W89*	56.48 b	-32.12			24.36 b	44.49	54.49
DW-4S	Yes	W89*	27.0 b	0.51			27.51 b	15.41	25.41
DW-4D	Yes	W89*	56.27 b	-28.56			27.71 b	44.36	54.36
DW-5S	Yes	W89*	25.48 b	-2.69			22.79 b	13.87	23.87
DW-5D	Yes	W89*	52.26 b	-29.5			22.76 b	40.63	50.63

AVAILABLE WELL CONSTRUCTION INFORMATION

Well No.	Selected?	Source of Information	Total Well Depth	Estimated Elevation of Well Bottom	Screened Unit(s)	Land Surface Elevation	Top of Casing Elevation	Top of Screen (depth)	Bottom of Screen (depth)
DW-6S	Yes	W89*	26.78 b	-5.25			21.53 b	14.80	24.80
DW-6D	Yes	W89*	57.64 b	-36.31			21.33 b	45.68	55.68
DW-7S	Yes	W89*	26.17 b	-3.26			22.91 b	14.62	24.62
DW-7D	Yes	W89*	53.54 b	-30.12			23.42 b	41.52	51.52

Well No.	Well Type	Date Installed	Drilling Method	Diameter	Screen Length	Screen Material	Top of Filter Pack (depth)	Filter Pack Material	Top of Bent Seal (depth)	Top of Grout (depth)	Grout Material	Surface Seal Material	Blank Material
A	observation	11-74		3"		sch40 PVC						concrete pad	sch40 PVC
B	observation	11-74		3"		sch40 PVC						concrete pad	sch40 PVC
C													
D	observation	11-74		3"		sch40 PVC						concrete pad	sch40 PVC
E	observation	11-74		3"		sch40 PVC						concrete pad	sch40 PVC
F	observation	11-74		3"		sch40 PVC						concrete pad	sch40 PVC
G	observation	11-74		3"		sch40 PVC						concrete pad	sch40 PVC
H	observation	11-74		3"		sch40 PVC						concrete pad	sch40 PVC
M-1	indust H2O sup?												
M-2													
M-3													
M-4													
M-5													
M-6				3"									
S-1													
S-2													
S-3													
WCC-1M													
WCC-1D	monitoring	1-81		2"	10	sch40 PVC	--			--	--		sch40 PVC
WCC-2M	monitoring	1-81		2"	10	sch40 PVC	42	sand		surface	mud		sch40 PVC
WCC-3D	monitoring	1-81		2"	10	sch40 PVC	--			--	--		sch40 PVC
WCC-3S													
WCC-3M				2"									
WCC-4M		1-81		2"	10	sch40 PVC	--			--	--		sch40 PVC
WCC-4D	monitoring												
WCC-4S													
WCC-5M	monitoring	1-81		2"	10	sch40 PVC	22	sand		surface	heavy mud		sch40 PVC
WCC-5S													
WCC-6D	monitoring	1-81		2"	10	sch40 PVC	--			--	--		sch40 PVC
WCC-6S													
WCC-6M													
WCC-7M	monitoring	1-81		2"	10	sch40 PVC	40	sand		surface	thick mud		sch40 PVC

Well No.	Well Type	Date Installed	Drilling Method	Diameter	Screen Length	Screen Material	Top of Filter Pack (depth)	Filter Pack Material	Top of Bent Seal (depth)	Top of Grout (depth)	Grout Material	Surface Seal Material	Blank Material
WCC-9M	monitoring	4-81		2"	10	sch40 PVC	42	sand		2	heavy mud	concrete	sch40 PVC
WCC-9S													
WCC-9D													
WCC-11D	monitoring	4-81		2"	10	sch40 PVC	52	sand		2	heavy mud	cement	sch40 PVC
WCC-11S													
WCC-11M													
WCC-12M	monitoring	4-81		2"	10	sch40 PVC	42	sand		2	heavy mud	cement	sch40 PVC
WCC-13M	monitoring	4-81		2"	10	sch40 PVC	41	sand		2	heavy mud	concrete	sch40 PVC
WCC-14S													
WCC-15M	monitoring	4-81		2"	10	sch40 PVC	34	sand		2	heavy mud	concrete?	sch40 PVC
WCC-15S													
WCC-15D													
WCC-16S													
WE-1		2-83	mud	1 1/4"	2'	PVC	21	sand	17	surface	Cemt Bent		PVC
WE-2		2-83	mud	1 1/4"	2'	PVC	21.5	sand	19	surface	Cemt Bent		PVC
WE-3			mud	1 1/4"	2'	PVC	20	sand	18	surface	Cemt Bent		PVC
WE-4			--	1 1/4"	2'	PVC	20	sand	18	surface	Cemt Bent		PVC
T-1	water supply												
T-2													
T-3													
No.1	Bennet Suction												
No.2	Bennet Suction												
No.3	Bennet Suction	1934		6"	15'								
No.4	Bennet Suction	pre-1934		10"	21'								
No.5	Bennet Suction	7-40		6"	15'								
No.6													
No.7													
No.8													
No.9	Bennet Suction	1912		6"	10'								
No.10	Bennet Suction	1911		8"	15'								
No.11	Bennet Suction	1911			15'								
No.12	Bennet Suction												
No.13	Bennet Suction	1911		6"	8"X10'								

Well No.	Well Type	Date Installed	Drilling Method	Diameter	Screen Length	Screen Material	Top of Filter Pack (depth)	Filter Pack Material	Top of Bent Seal (depth)	Top of Grout (depth)	Grout Material	Surface Seal Material	Blank Material
No.14													
No.15													
No.16	Bennet Suction												
No.17	Bennet Suction												
No.18													
No.19	Bennet Suction												
No.20													
No.21													
No.22													
Layne #1A													
Layne #1													
Layne #2													
Layne #3													
Layne #4													
Layne #5													
Schoor #1													
Schoor #2													
Schoor #3													
Schoor #4													
DEP-1		10-82	HSA	2"	10	20slot PVC							PVC
DEP-2	monitoring	10-82	HSA	2"	12.3	20slot PVC							PVC
DEP-3													
DEP-4		10-82	HSA	2"	10	20slot PVC							PVC
DW-1S	monitoring	?	HSA	2"	10	PVC	12	sand	10	5	cemt bent	cement	PVC
DW-1D	monitoring	10-88		2"	10	PVC	40	sand	38	5	cemt bent	cement	PVC
DW-2S	monitoring	10-88		2"	10	PVC	11.5	sand	10	4	cemt bent	cement	PVC
DW-3S	monitoring	10-88	HSA	4"	10	PVC	12	sand	10	5	cemt bent	cement	PVC
DW-3D	monitoring	10-88		4"	10	PVC	42	sand	40	5	cemt bent	cement	PVC
DW-4S	monitoring	11-88	HSA	2"	10	PVC	12.3	sand	10.3	4	cemt bent	cement	PVC
DW-4D	monitoring	11-88		2"	10	PVC	40	sand	37	4	cemt bent	cement	PVC
DW-5S	monitoring	10-88	HSA	2"	10	PVC	11.8	sand	9.8	4	cemt bent	cement	PVC
DW-5D	monitoring	10-88		2"	10	PVC	35.7	sand	33.8	4	cemt bent	cement	PVC

Well No.	Well Type	Date Installed	Drilling Method	Diameter	Screen Length	Screen Material	Top of Filter Pack (depth)	Filter Pack Material	Top of Bent Seal (depth)	Top of Grout (depth)	Grout Material	Surface Seal Material	Blank Material
DW-6S	monitoring	10-88	HSA	2"	10	PVC	12	sand	9	4.5	cemt bent	cement	PVC
DW-6D	monitoring	10-88		2"	10	PVC	42	sand	40	4	cemt bent	cement	PVC
DW-7S	monitoring	10-88		2"	10	PVC	11.5	sand	8.8	4	cemt bent	cement	PVC
DW-7D	monitoring	10-88		2"	10	PVC	38	sand	35	4	cemt bent	cement	PVC

Well No.	Comment
A	Also called "AD-" and "PA-"
B	Also called "AD-" and "PA-"
C	
D	Also called "AD-" and "PA-"
E	Also called "AD-" and "PA-"
F	
G	
H	
M-1	Also called "MI-"
M-2	Also called "MI-"
M-3	Also called "MI-"
M-4	Also called "MI-"
M-5	Also called "MI-"
M-6	Also called "MI-"
S-1	
S-2	
S-3	
WCC-1M	
WCC-1D	
WCC-2M	Also called WCC-2
WCC-3D	
WCC-3S	
WCC-3M	
WCC-4M	See note at bottom of table.
WCC-4D	See note at bottom of table.
WCC-4S	
WCC-5M	
WCC-5S	
WCC-6D	
WCC-6S	
WCC-6M	
WCC-7M	

Well No.	Comment
WCC-9M	
WCC-9S	
WCC-9D	
WCC-11D	
WCC-11S	Also called WCC-11VS
WCC-11M	
WCC-12M	
WCC-13M	
WCC-14S	
WCC-15M	Well Depth reported for "WCC-15", assummed to be WCC-15M
WCC-15S	
WCC-15D	
WCC-16S	Also called WCC-16VS
WE-1	pumped 125-150 gals to develop
WE-2	pumped 125-150 gals to develop
WE-3	pumped 125-150 gals to develop
WE-4	pumped 125-150 gals to develop
T-1	Also called MI-T-1, M1-T1, or MI-T1
T-2	
T-3	
No.1	
No.2	
No.3	shut down 2/72, 6/73
No.4	shut down 12/1/70
No.5	shut down 2/72, 6/73
No.6	
No.7	
No.8	
No.9	shut down 2/72, 6/73, Also B-9
No.10	shut down 2/72, 6/73, Also B-10
No.11	shut down 2/72, 6/73, Also B-11
No.12	
No.13	shut down 2/72, 6/73, Also B-13

Well No.	Comment
No.14	
No.15	
No.16	poss. also screened in Old Bridge
No.17	
No.18	
No.19	poss. also screened in Old Bridge
No.20	
No.21	
No.22	
Layne #1A	
Layne #1	
Layne #2	
Layne #3	
Layne #4	
Layne #5	
Schoor #1	Also called SE-1
Schoor #2	Also called SE-2
Schoor #3	Also called SE-3
Schoor #4	Also called SE-4
DEP-1	Also called ST-1
DEP-2	Also called ST-2
DEP-3	
DEP-4	Also called ST-4
DW-1S	developed by centrifugal pump for at least 2 hours
DW-1D	developed by centrifugal pump for at least 2 hours
DW-2S	developed by centrifugal pump for at least 2 hours
DW-3S	developed by centrifugal pump for at least 2 hours
DW-3D	developed by centrifugal pump for at least 2 hours
DW-4S	developed by centrifugal pump for at least 2 hours
DW-4D	developed by centrifugal pump for at least 2 hours
DW-5S	developed by centrifugal pump for at least 2 hours
DW-5D	developed by centrifugal pump for at least 2 hours

Well No.	Comment
DW-6S	developed by centrifugal pump for at least 2 hours
DW-6D	developed by centrifugal pump for at least 2 hours
DW-7S	developed by centrifugal pump for at least 2 hours
DW-7D	developed by centrifugal pump for at least 2 hours

NOTES:

(1) Table contains information specifically presented in available documents.
(2) All elevations and depths are in feet.
(3) A 'Yes' in the 'Selected' column indicates that the well is listed in the table presented as Appendix A.9.
(4) Well Survey Coordinates were not available for any wells.
(5) Additional well depth and top of casing information received from NJDEP on 6-9-89 could not be incorporated into this Draft FS.

* = Reference includes well log. Log for WCC-4X (Wehran 1986) is identified as both WCC-4M and WCC-4D.
Professional judgement used to differentiate well log information for Wells WCC-4M and WCC-4D.
Logs for WE-1 and WE-2 given in Wehran 1986 are for test borings (grouted). Well construction logs given in Wehran 1983.

a = Wehran 1986. Ground surface elevation is plus or minus two feet.
b = Wehren 1989. Note: Total Well Depth = Depth of well below top of protective casing.
c = Dames and Moore 1980. Well depths estimated from cross sections.
d = Wehren 1983
e = Ad-Tek 1975
? = Data illegible or otherwise questionable
AD = Ad-Tek 1975
DM80 = Dames and Moore 1980
Con83 = Converse Consultants 1983
W83 = Wehran 1983
W86 = Wehran 1986
W89 = Wehran 1989

APPENDIX A-6

WELL LOGS AND WELL RECORDS

USEABLE WELL LIST

Well	Total Depth (feet)	Screen Depth (feet)	Unit	Detected Values
A	51.5/50	NA	OB	YES
B	52/47.5	NA	OB	YES
D	52/49.0	NA	OB	YES
E	40	NA	OB	YES
F	58.0	NA	OB	YES
G	40.0	NA	OB	YES
H	36.0	NA	OB	YES
S-1	30.0	NA	OB	YES
S-3	25.0	NA	OB	YES
WCC-1M				YES
WCC-1D	101.25	91 - 101	OB	YES
WCC-2M	55.75	45/46 - 55/56	OB	YES
WCC-3M				YES
WCC-3D	81/80.25	71 - 81	OB	YES
WCC-4M(D)	80.16	47 - 57	OB	YES
WCC-6S				YES
WCC-6M				YES
WCC-6D	80/80.5	65 - 75	OB	YES
WCC-7M	55.1	45 - 55	OB	YES
WCC-9M	55.5/56.5	45 - 55	OB	YES
WCC-11S				YES
WCC-11M				YES
WCC-11D	71.5	55 - 65	OB	YES
WCC-12M	56.5	45 - 55	OB	YES
WCC-13M	56.5	44 - 54	OB	YES
WCC-15M	51.5	38 - 48	OB	YES
WCC-16S				YES
NO.3	58	NA	OB	YES
NO.4	38+	NA	OB	YES
NO.5	54	NA	OB	YES
NO.10	61/71	NA	OB/SA	YES
NO.11	52/51.75	NA	OB	YES
NO.13	50/60.63/58	NA	OB	YES
NO.16	71.7	NA	OB/SA	YES
NO.19	74.0	NA	OB/SA	YES
L-4	70	NA	OB	YES
M-2				YES
M-6				YES
DEP-1				YES
DEP-2				YES
DEP-4				YES
DW-1S				YES
DW-1D				YES
DW-2S				YES
DW-3S				YES
DW-3D				YES
DW-4S				YES

DW-4D	YES
DW-5S	YES
DW-5D	YES
DW-6S	YES
DW-6D	YES
DW-7S	YES
DW-7D	YES

NA = not available
OB = Old Bridge Aquifer
SA = South Amboy Fire Clay
Detected Values = one or more of the five constituents of concern were detected in samples collected from the well

SOURCE: AD-TEK 1975

1 BORING NO.
4-3-73 DATE
NA ELEVATION

BORINGS BY
TECHNICAL TESTING CO

CASING IN GROUND 11'-6
CASING INSTALLED 14'-0
SOIL SAMPLING 2'-0

CASING BLOWS/1'	DEPTH-FT	SAMPLE	SAMPLE NO.	SAMPLER BLOWS/6"	DEPTH OF STRATA	DESCRIPTION OF STRATA
	0				0'-0"	
2	1					
2	2					
5	3					
7	4					
10	5					
20	6					
53	7					
60	8					
64	9					
69	10					
80	11				11'-6"	Bottom of Installed Casing
42/6"	12					Brown M-C SAND, Trace GRAVEL
	13		1	NOT RECORDED	13'-6"	Trace SILT
	14					Sampling Operation Terminated At 13'-6"

__Location__
Within the Madison Township Sewerage Authority Easement north east of Jernees Mill Road and north west of Old Water Works Road.

TECHNICAL TESTING INC

CASING INSTALLATION
73-54/So-939

2 BORING NO.
4-3-73 DATE
NA ELEVATION

BORINGS BY
TECHNICAL TESTING CO

CASING IN GROUND 11'-6"
CASING INSTALLED 14'-0"
SOIL SAMPLING 2'-0"

CASING BLOWS/1'	DEPTH-FT	SAMPLE	SAMPLE NO.	SAMPLER BLOWS/6"	DEPTH OF STRATA	DESCRIPTION OF STRATA
	0				0'-0"	
3	1					
7	2					
8	3					
10	4					
15	5					
35	6					
38	7					
47	8					
50	9					
58	10					
73	11				11'-6"	Bottom of Installed Casing
48/6"	12					
	13		1	NOT RECORDED		Light Brown F-M SAND, Trace GRAVEL, Trace SILT
	14				13'-6"	

Sampling Operation Terminated At 13'-6"

Location
Within the Madison Township Sewerage Authority Easement, approximately three feet north east of the manhole at the intersection of Runyon-Cheesequake Rd. and Old Water Works Road.

CASING INSTALLATION
73-54/So-939

3	BORING NO.
4-4-73	DATE
NA	ELEVATION

BORINGS BY
TECHNICAL TESTING CO

CASING IN GROUND 10'-0"
CASING INSTALLED 13'-0"
SOIL SAMPLING 2'-0"

CASING BLOWS/1'	DEPTH-FT	SAMPLE	SAMPLE NO.	SAMPLER BLOWS/6"	DEPTH OF STRATA	DESCRIPTION OF STRATA
	0				0'-0"	
11	1					
21	2					
34	3					
51	4					
63	5					
73	6					
96	7					
109	8					
183	9					
200	10				10'-0"	Bottom of Installed Casing
	11		1	NOT RECORDED		Brown F-M SAND, Trace GRAVEL, Trace SILT
	12				12'-0"	

Sampling Operation Terminated At 12'-0"

Location
Within the Madison Township Sewerage Authority Easement, approximately 2500 feet north east of the intersection of Jernees Mill Road and Old Water Works Road.

A-57

73-34/SO-939

4 BORING NO.
4-6-73 DATE
NA ELEVATION

BORINGS BY TECHNICAL TESTING CO

CASING IN GROUND 6'-0"
CASING INSTALLED 10'-0"
SOIL SAMPLING 2'-0"

CASING BLOWS/1'	DEPTH-FT	SAMPLE	SAMPLE NO.	SAMPLER BLOWS/6"	DEPTH OF STRATA	DESCRIPTION OF STRATA
	0				0'-0"	
7	1					
23	2					
47	3					
81	4					
96	5					
135	6				6'-0"	Bottom of Installed Casing
	7					Brown M-C SAND, Trace GRAVEL,
	8		1	NOT RECORDED	8'-0"	Trace SILT
						Sampling Operation Terminated At 8'-0"
						Location Within the Madison Township Sewerage Authority Easement adjacent to the Food Additives Plant property.

TECHNICAL TESTING INC.

ADTEK ENGINEERING, INC.
P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

Project: City of Perth Amboy
Pricketts Brook Watershed-Observation Wells

Boring No: Well A
Date: 11/7/74
Comments: Installed 3" I.D. PVC Sched. 40 Plastic Pipe to 50.0'

Casing Hammer
Wt. 300# Fall 24"

Sampler Hammer
Wt. 140# Fall 30"
Casing I.D. 4"
Sampler O.D. 2"

Classification of Materials

F - Fine	And	35-50%
M - Medium	Some	20-35%
C - Course	Little	10-20%
	Trace	0-10%

Strata Changes (ft.)	Description
0.0-0.5	Dark grey M-F sand; Tr. silt, Tr. roots
0.5-3.0	Lt. grey M-F sand; Tr. silt; Tr. Veg.
3.0-9.0	Mottled yellow, Red-Brn C-M-F sand; some C-M-F Quartzite gravel; Tr. silt
9.0-15.0	Yell-Brn. C-M-F sand; Tr. silt
15.0-25.0	Yell-Brn. C-M-F sand; Tr. silt
25.0-29.0	Lite grey(streaks of Yell) silt; Little clay; Tr. F sand & clay occurs in laminations
29.0-34.0	Grey clayey-silt-partings F sand
34.0-40.0	Grey C-M-F sand; Tr. silt
40.0-50.0	Grey (streaks of Yell) C-M-F sand Little silt; Tr. clay; Tr.lignite
50.0'	Bottom of Boring

ADTEK ENGINEERING, INC.
P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

roject: City of Perth Amboy
Pricketts Brook Watershed-Observation Wells

Boring No: Well B
Date: 11/11/74
Comments: Installed 3" I.D.
Perf'd PVC Sched. 40
Plastic Pipe to 47.5'

Casing Hammer
Wt. 300# Fall 24"

Sampler Hammer
Wt. 140# Fall 30"
Casing I.D. 2 1/2"
Sampler O.D. 2"

Classification of Materials

F - Fine
M - Medium
C - Course

And	35-50%
Some	20-35%
Little	10-20%
Trace	0-10%

Strata Changes (ft)	Description
0.0-0.5	Dk. grey M-F sand; Tr. silt; Tr. Veg.
0.5-5.0	Dk. yell-Brn. M-F sand; Tr. silt
5.0-10.0	Grey C-M-F sand; Tr. silt *encountered grd. water @ 5'
10.0-13.0	Grey C-M-F sand; Tr. silt; Tr. lignite
13.0-25.0	Grey C-M-F sand; Tr. silt; Note: Extremely fast running sand @ 17.0'-20.0' prohibit proper cleaning out casing-jarred "wash" sample
25.0-35.0	Grey C-M-F sand; Tr. silt; layers (Approx. 6-8') grey-Brn silt and clay
35. 40.0	Lite grey C-M-F sand; Tr. silt; Tr. lignite; partings grey clay
40.0-52.0	Lite grey C-M-F sand; Tr. silt
52.0	Bottom of boring

ADTEK ENGINEERING, INC.
P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

Project: City of Perth Amboy
Pricketts Brook Watershed-Observation Wells

Boring No: D
Date: 11/22/74
Comments: Installed 3" I.D.
PVC Sched. 40 Plastic
Pipe to 49.0'

Casing Hammer
Wt. 300# Fall 24"

Sampler Hammer
Wt. 140# Fall 30"
Casing I.D. 4"
Sampler O.D. 2"

Classification of Materials

F - Fine
M - Medium
C - Course

And	35-50%
Some	20-35%
Little	10-20%
Trace	0-10%

Strata Changes (ft.)	Description
0.0-10.0	No samples taken
10.0-20.0	Orange & yell. C-M-F sand; Little clayey-silt; Trace F gravel
20.0-31.0	Yell, grey & orange C-M-F sand; tr. silt
31.0-35.0	Grey & Orange-Brn M-F sand; Little clayey-silt
35.0-40.0	Grey M-F sand; Little clayey-silt; Tr. lignite
40.0-45.0	Mottled yellow & grey M-F sand; Little clayey-silt; trace lignite; trace mica flakes
45.0-52.0	Grey & yellow C-M-F sand; Trace silt
52.0	Bottom of Boring

ADTEK ENGINEERING, INC.
P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

Project: City of Perth Amboy
Pricketts Brook Watershed-Observation Wells

Boring No: E
Date: 11/21/74
Comments: Installed 3" I.D. PVC Sched. 40 Plastic Pipe to 40'

Casing Hammer
Wt. 300# Fall 24"

Sampler Hammer
Wt. 140# Fall 30"
Casing I.D. 4"
Sampler O.D. 2"

Classification of Materials

F- Fine
M - Medium
C - Course

And 35-50%
Some 20-35%
Little 10-20%
Trace 0-10%

Strata Changes (Ft.)	Description
0.0-10.0	No samples taken
10.0-20.0	Orange & yellow C-M-F sand; little C-M-F Quartzite gravel; trace silt
20.0-30.0	Grey & Yellow M-F sand; little clayey-silt
30.0-31.0	Grey, Yell, Orng.M-F sand; Tr. silt
31.0-31.5	Layer lite grey silt and clay; Tr. F sand
31.5-40.0	Resume grey, yell, orange M-F sand; Tr.silt
40.0'	Bottom of boring

ADTEK ENGINEERING, INC.
P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

Project: City of Perth Amboy
Pricketts Brook Watershed-Observation Wells

Boring No: F	**Casing Hammer**
Date: 11/14/74	Wt. 300# Fall 24"
Comments: Installed 3" I.D.	
PVC Sched. 40 Plastic	**Sampler Hammer**
Pipe to 58.0'	Wt. 140# Fall 30"
	Casing I.D. 4"
	Sampler O.D. 2"

Classification of Materials

F - Fine	And 35-50%
M - Medium	Some 20-35%
C - Course	Little 10-20%
	Trace 0-10%

Strata Changes (ft.)	Description
0.0-3.0	1" cracked stone, cinders, sand (fill)
3.0-10.0	Yellow-Brn M-F sand; trace silt
10.0-15.0	Yell-(tr ornage) M-F sand; Tr silt; Tr F Quartzite gravel
15.0-19.0	Yellow C-M-F sand; Tr silt
19.0-29.0	Mottled orgn, yell, red M-F sand; tr silt
29.0-40.0	Orange-Brn C-M-F sand; Tr silt
40.0-49.0	Lite yellow (tr. red) C-M-F sand; tr. silt
49.0-55.0	Grey M-F sand; Little Clayey-silt Tr. lignite
55.0-61.0	Grey & yell M-F sand; Trace clayey-silt
61.0	bottom of Boring

ADTEK ENGINEERING, INC.
P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

Project: City of Perth Amboy
Pricketts Brook Watershed-Observation Wells

Boring: G
Date: 11/15/74
Comments: Installed 3" I.D. PVC Sched. 40 plastic pipe to 40.0'

Casing Hammer
300# Wt. Fall 24"

Sampler Hammer
Wt. 140# Fall 30"
Casing I.D. 4"
Sampler O.D. 2"

Classification of Materials

F - Fine
M - Medium
C - Course

And	35-50%
Some	20-35%
Little	10-20%
Trace	0-10%

Strata Changes (ft.)	Description
0.0-10.0	Miscell. fill (sand, Conc., Trees) No samples taken 0-10'
10.0-20.0	Grey M-F sand; Trace silt
20.0-41.5	Orange & yellow C-M-F Sand; Trace silt
41.5-42.0	Yellow & red clayey-silt; Tr F sand
42.0	Bottom of boring

ADTEK ENGINEERING, INC.
P.O. Box 112, North Branch, N.J.

SUBSURFACE EXPLORATIONS

Project: City of Perth Amboy
Pricketts Brook Watershed-Observation Wells

Boring: H
Date: 11/18/74
Comments: Installed 3" I.D.
PVC Sched. 40 plastic
pipe to 36.0'

Casing Hammer
300# fall 24"

Sampler Hammer
140# Wt. Fall 30"
Casing I.D. 4"
Sampler O.D. 2"

Classification of Materials

F - Fine
M - Medium
C - Course

And	35-50%
Some	20-35%
Little	10-20%
Trace	0-10%

Strata Changes (ft.)	Description
0.0-10.0	No samples taken 0-10'
10.0-20.0	Grey & Yellow C-M-F sand; tr silt
20.0-38.0	Yellow C-M-F sand; Tr silt; Tr F Quartzite gravel
38.0-39.0	Yellow C-M-F sand; Tr silt; Trace Clay (small "pockets"); trace wood
39.0	bottom of boring

PERTH AMBOY SUCTION WELLS

No. 3 Existing- size 6", depth 58', s.s.screen 15'

Log:
0-10 Yellow to light sand
10-23 Yellow to light gray sand
23-29 clay
29-30 Hard pan
30- 58'10" Coarse gray water sand

Installed 1934
Replaced 1963
Installed submersible pump to sewer - 3/73
State order shut-downs 2/72, 6/73

No 5 Existing- size 6", depth 54', s.s.screen 15'

Log:
0-10 Yellow to light sand
10-23 Yellow to light gray sand
23-29 clay
29-30 Hard pand
30- 58' 10" coarse gray water sand ~~clay~~
58'10" - clay

Installed 7/16/40
Replaced 4/26/63
Shut-downs- 2/72, 6/73

No. 9 Existing- size 6", depth 57', s.s.screen 10'

Log:
0-10 light yellow sand
10-23 light gray sand
23-30 clay with small portion gravel
30- 57' 10" gray water sand

57' 10" - clay

Installed 1912
Replaced- 7/40,6/48,11/53
Shut-downs-2/72, 6/73

No. 10 Existing- size 8", depth 61', s.s.screen 15'

Log:
0 -10 Brown sand and gravel
10-42 Lt. Brn. sand streaks white clay
42-47 white - yellow clay
47-65 Fine to coarse lt. brown sand
65-71 White sandy clay

Installed 1911
Replaced 7/26,1957,1963
Shut-downs-2/72,6/73

No. 11 Existing- size 6", depth 52', s.s.screen 15'

Log:
0-13 Dirty yellow sand
13-15 Gray sand
15-19 gray clay
19-27 Brown sand - gravel
27-40 gray sand
40-41 gray clay
41-46 Brown sand
46- 51' 8" gray clay

Installed 1911
Replaced 1952, 1963
Shut-downs 2/72, 6/73

Water Sample 1/1/63		
Tot.Sol.	166	ppm
CO_3Hard.	5.5	
Non-CO_3	32.5	
Tot.Hard.	38.0	
Ca Hard.	26.0	
Chloride	5.0	
Alk.M.O.	5.5	
Free Carb.Acid(CO_2)	69.5	
Fe	1.7	

PERTH AMBOY SUCTION WELLS

No. 13 Existing- size 6", depth 50'?, s.s.screen 8"x10'

Installed 1911
Replaced- 1/2/51, 6/27/57
Shut-down 2/72, 6/73

Log:		
	0-6	Topsoil & sand
	6-9	Gravel & sand
	9-11	sand
	11-18	sand, clay & gravel
	18-21	sand, wood & clay
	21-26	sand
	26-28	sand & clay balls
	28-35	sand pyrite & clay
	35-40	coarse sand
	40-50	coarse sand & clay balls
	50-54	Brn. sand & clay balls
	54-58	muddy sand & clay

No. 4 Existing- size 10", depth 38'+ screen L=21'

Installed prior to 1934
Replaced- 1934, 1940

NO LOG

12/1/70- Filled with iron & fibrous white jelly. Sounded to 38'-6" & shut down.

Ad Tek

PERTH AMBOY SUCTION WELLS

No. 3 Existing- size 6", depth 58', s.s.screen 15'

LOg: 0-10 Yellow to light sand
10-23 Yellow to light gray sand
23-29 clay
29-30 Hard pan
30- 58'10" Coarse gray water sand

Installed 1934
Replaced 1963
Installed submersible pump to sewer - 3/73
State order shut-downs 2/72, 6/73

No 5 Existing- size 6", depth 54', s.s.screen 15'

Log: 0-10 Yellow to light sand
10-23 Yellow to light gray sand
23-29 clay
29-30 Hard pand
30- 58' 10" coarse gray water sand ~~clay~~
58'10" - clay

Installed 7/16/40
Replaced 4/26/63
Shut-downs- 2/72, 6/73

No. 9 Existing- size 6", depth 57', s.s.sceeen 10'

LOg: 0-10 light yellow sand
10-23 light gray sand
23-30 clay with small portion gravel
30- 57' 10" gray water sand

57' 10" - clay

Installed 1912
Replaced- 7/40,6/48,11/53
Shut-downs-2/72, 6/73

No. 10 Existing- size 8", depth 61', s.s.screen 15'

Log: 0 -10 Brown sand and gravel
10-42 Lt. Brn. sand streaks white clay
42-47 white - yellow clay
47-65 Fine to coarse lt. brown sand
65-71 White sandy clay

Installed 1911
Replaced 7/26,1957,1963
Shut-downs-2/72,6/73

No. 11 Existing- size 6", depth 52', s.s.screen 15'

Log: 0-13 Dirty yellow sand
13-15 Gray sand
15-19 gray clay
19-27 Brown sand - gravel
27-40 gray sand
40-41 gray clay
41-46 Brown sand
46- 51' 8" gray clay

Installed 1911
Replaced 1952, 1963
Shut-downs 2/72, 6/73

Water Sample 1/1/63

Tot.Sol.	166	ppm
CO_3 Hard.	5.5	
Non-CO_3	32.5	
Tot.Hard.	38.0	
Ca Hard.	26.0	
Chloride	5.0	
Alk.M.O.	5.5	
Free Carb.Acid(CO_2)	69.5	

SOURCE: WEHRAN 1983

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. (BORING) WE-1

PROJECT: CPS CHEMICAL
CLIENT: CPS CHEMICAL
BORING CONTRACTOR: [illegible] DRILLING
GROUND WATER

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE	[illegible]	SS		
DIA.		2"		
WT.		140lbs.		
FALL		30"		

SHEET NO. 1 OF 2
JOB NO. [illegible]
ELEVATION 25.69
DATE STARTED [illegible]
DATE FINISHED [illegible]
DRILLER M. [illegible]
INSPECTOR [illegible]

WELL CONSTRUCTION: CEMENT - BENTONITE GROUT

DEPTH IN FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	HNU	REMARKS
0	S-1 A-B	SS	2-10 20-7	dark brown + black f-m-c SAND and c-m-f GRAVEL, little silt + clay	1.4/1.4	
	S-2 A-B-C	SS	1-7 8-6	grey, black + tan f-m SAND, some silt, trace clay	1.8 1.9/2.7	
5	S-3	SS	13-17 8-13	tan f-m SAND, little silt, trace clay	2.2	
	S-4	SS	18-21 21-19	tan + orange m-f-c SAND, some f-m Gravel, little silt, trace clay	2.1	
	S-5 A-B	SS	22-27 31-22			
10	S-6 A-B	SS	36-38 42-19	orange f-m GRAVEL, some c-m-f sand, little silt	2.8/2.1 4.0/10.6	
	S-7 A-B	SS	27-39 20-12	tan m-f SAND, trace silt	7.8/14.5	
15	S-8	SS	10-2 22-13		5.2	
	S-9	SS	19-24 12-10		2.4	
	S-10	SS	8-14 13-12		2.4	
20	S-11	SS	21-22 16-19		2.6	
	S-12	SS	25-21		2.6	
	S-13 A-B	SS	9-11 17-17	- grading to f-m SAND, trace silt	5.0/2.5	
25	S-14	SS	11-16 20-26		2.2	
	S-15	SS	17-40 45-26	occassional black, grey, yellow, orange, and reddish orange staining	2.6	
30	S-16	SS	10-11 16-18		2.0	
	S-17	SS	7-8 10-11		2.0	
35	S-18	SS	11-15 26-39		2.6	
	S-19	SS	10-14 14-23		2.5	
	S-20	SS	15-32 68-100/5"		2.8	
40	S-21	SS	100/5"		4.6	
	S-22	SS	22-24 18-22		5.4	
45	S-23	SS	8-6 2-18		5.3	
	S-24	SS	16-17 22-[illegible]		5.4	

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. (WELL) WE-1

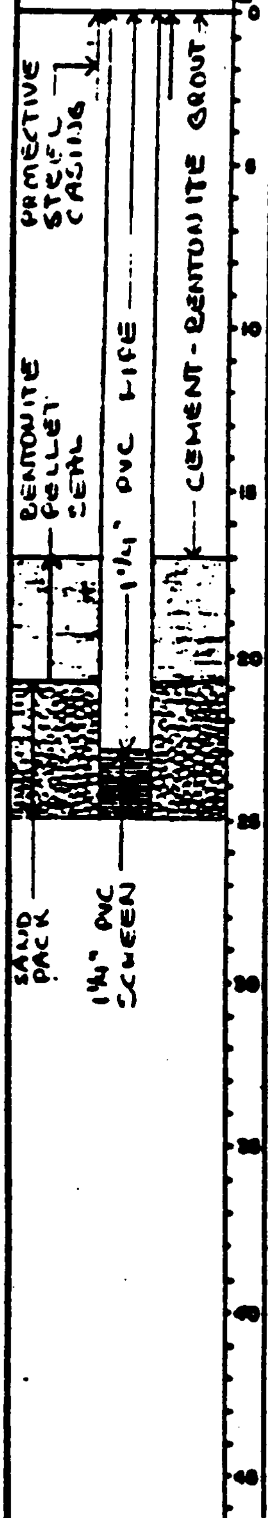
PROJECT: CFS CHEMICAL	SHEET NO. 1 OF 1
CLIENT: CFS CHEMICAL	JOB NO. 0226-5517
BORING CONTRACTOR: KENDRICK DRILLING	ELEVATION 25.69
	DATE STARTED 2/10/83
	DATE FINISHED 2/11/83
	DRILLER M. RYAN
	INSPECTOR I. KLOTZSCH

GROUND WATER

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE	MUD	SS		
DIA.		2"		
WT.		140 lb.		
FALL		30"		

WELL CONSTRUCTION	DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS



WELL WE-1 DRILLED IMMEDIATELY ADJACENT TO BORING WE-1. PLEASE SEE LOG FOR BORING WE-1 FOR DETAILED SOIL CLASSIFICATIONS.

25.0'

END OF BORING

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. WE-2 (BORING

PROJECT: CPS CHEMICAL	SHEET NO. 1 OF 2
CLIENT: CPS CHEMICAL	JOB NO. 02362217
BORING CONTRACTOR: KENDRICK DRILLING	ELEVATION [illegible]
	DATE STARTED 2/24/83
	DATE FINISHED 2/25/83
	DRILLER [illegible]
	INSPECTOR [illegible]

GROUND WATER

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE	MUD	SS		
DIA.		2"		
WT.		140lbs		
FALL		30"		

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
CEMENT - BENTONITE GROUT	0	S-1	SS	1-5 5-8	dark brownish black f-m-c SAND, little+ Silt+Clay, trace f-m Gravel	
		S-2	SS	15-13 15-19		
	5	S-3	SS	9-13 20-25	dark brownish black f-m-c SAND, little Silt+Clay	
		S-4	SS	19-24 23-22	tan f-m SAND, trace+ Silt; brown staining at 7.0'	
		S-5	SS	14-15 16-18	- grading to light brown	
	10	S-6 A+B	SS	7-5 14-16	10.0' tan SILT+CLAY, little+ f Sand 11.5'	
		S-7	SS	10-16 19-28	greyish tan f-m SAND, trace+ Silt	
	15	S-8	SS	10-22 22-16	tan f-m SAND, little Silt - grading to grey 16.0'	
		S-9 A+B	SS	5-16 24-35	tanish grey SILT, some Clay 16.7' grey f-m SAND, trace+ Silt	
	20	S-10	SS	14-16 21-27	grey f-m SAND, some- Silt	
		S-11	SS	14-11 14-35	- grading to medium brown	
		S-12	SS	12-18 36-100/6	tan to grey f-m SAND, little Silt+Clay	
	25	S-13	SS	28-43 65-100/3	grey f-m SAND, trace+ Silt	
	30	S-14	SS	8-13 18-22	dark brown-black f-m SAND, little- Silt	
	35	S-15	SS	4-13 43-74	light grey f-m SAND, little- Silt	
	40	S-16 A+B	SS	26-29 30-33	- grading to some- Silt at 40.5' grey very f SAND, little Silt	
	45	S-17	SS	13-21 24-43	light grey f-m SAND, little+ Silt	

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG
BORING NO. (BORING) WE-2
SHEET NO. 5 OF 5
JOB NO. 08356617

PROJECT: CPS CHEMICAL
CLIENT: CPS CHEMICAL

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
CEMENT - BENTONITE GROUT (45' to 76.7')	45	S-17	SS	12-21 / 34-40		
	50	S-18	SS	21-42 / 52-76	greyish tan m-f-c SAND, trace+ Silt — 53.3'	
		S-19 A,B,C	SS	20-22 / 24-86	grey + tan SILT + CLAY to CLAY + SILT — 54.6'	
	55				tan + grey m-f SAND, trace Silt	
	60	S-20	SS	39-32 / 26-23	grey + tan m-f SAND, little Silt + Clay	
	65	S-21	SS	91-100/5	tan + grey f-m SAND, trace Silt	
	70	S-22	SS	76-100/3	grey to tan m-c-f SAND; orange staining	
	75	S-23	SS	41-41 / 52-59	- cream, red, and yellow staining — 76.7'	
					END OF BORING	
	80					
	85					
	90					
	95					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. WE-2 (WELL)

SHEET NO. 1 OF 1

JOB NO. 0236[illegible]

ELEVATION 24.71

DATE STARTED 5/24/83

DATE FINISHED 5/26/83

DRILLER M. RYAN

INSPECTOR I. KLOTZSCH

PROJECT: CFS CHEMICAL

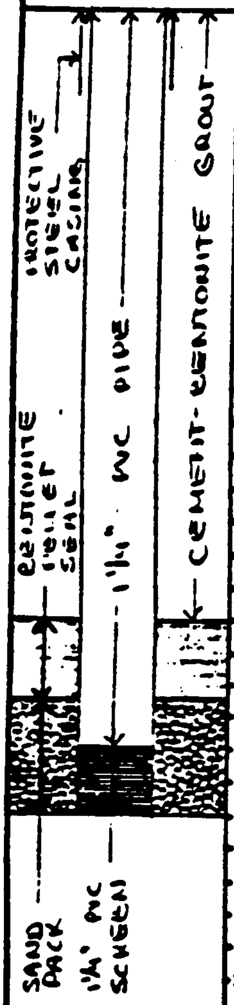
CLIENT: CFS CHEMICAL

BORING CONTRACTOR: KETCHICK'S DRILLING

GROUND WATER

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE	MUD	SS		
DIA.		2"		
WT.		140 lbs		
FALL		30"		

WELL CONSTRUCTION	DEPTH IN FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0–45				WELL WE-2 DRILLED IMMEDIATELY ADJACENT TO BORING WE-2. PLEASE SEE LOG FOR BORING WE-1 FOR DETAILED SOIL CLASSIFICATIONS.	
	25.0'				END OF BORING	

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. WE-2

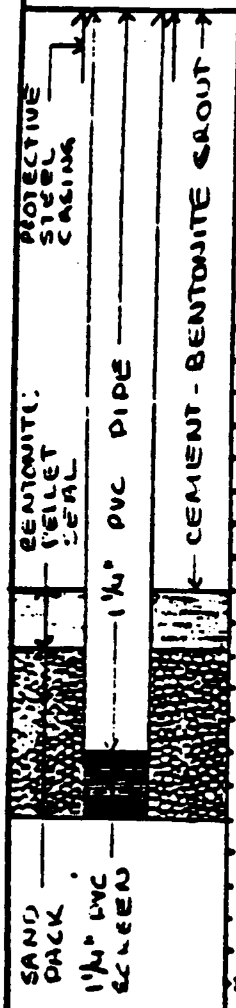
PROJECT: CPS CHEMICAL	SHEET NO. 1 OF 1
CLIENT: CPS CHEMICAL	JOB NO. 02362217
BORING CONTRACTOR: KENDRICK DRILLING	ELEVATION 27.11
	DATE STARTED 2/21/83
	DATE FINISHED 6/22/83
	DRILLER M. RYAN
	INSPECTOR I. KLOTZSCH

GROUND WATER

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE	HUD	SS		
DIA.		2"		
WT.		140 lbs.		
FALL		30"		

WELL CONSTRUCTION



DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	HNU	REMARKS
0	S-1	SS	5-15 / 17-18	light brown to tan f-m SAND, little silt + clay		
	S-2	SS	16-21 / 29-36	yellowish orange m-f SAND, trace silt + clay		
5	S-3	SS	26-29 / 27-25			
	S-4	SS	14-18 / 35-40	light grey f SAND, little Silt, trace Clay		
10	S-5	SS	14-31 / 52-60			
	S-6	SS	19-21 / 22-22			
	S-7	SS	9-11 / 15-26	2" yellowish staining at 13.5'		
15	S-8	SS	12-21 / 22-17	-grading to greenish grey		
	S-9	SS	15-25 / 28-30	tan to grey m-f SAND, trace silt		
	S-10	SS	11-28 / 100/5.5	- grading to grey		
20	S-11	SS	22-22 / 22-57	light grey f SAND, little Silt, trace Clay.		
	S-12	SS	14-30 / 46-44			
	S-13	SS	27-28	25.0'	4.8	
25				END OF BORING		
30						
35						
40						
45						

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. WE-4

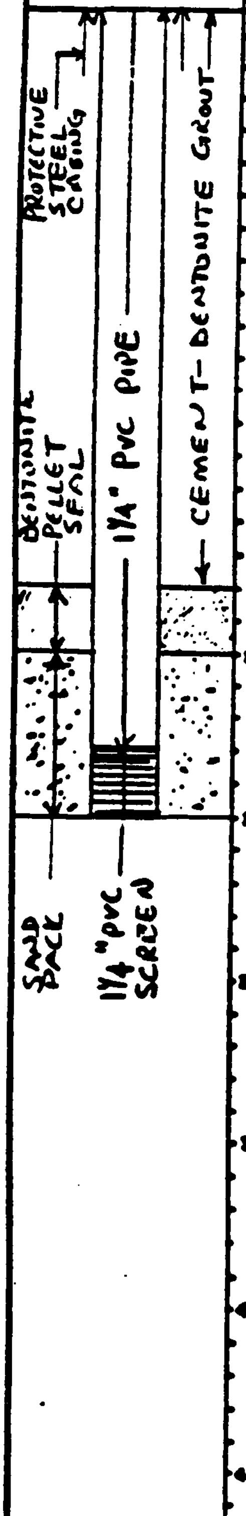
PROJECT:	CFC CHEMICAL
CLIENT:	CFC CHEMICAL
BORING CONTRACTOR:	KENDRICK DRILLING
SHEET NO.	1 OF 1
JOB NO.	C6346617
ELEVATION	24.19
DATE STARTED	[illegible]
DATE FINISHED	[illegible]
DRILLER	H. RYAN
INSPECTOR	L. KLOTZSCH

GROUND WATER

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE		SS		
DIA.		2"		
WT.		140#		
FALL		30"		

WELL CONSTRUCTION



SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
1	SS	5-13, 11-12	medium brown f SAND, little Silt+Clay	
2	SS	12-18, 19-19	-grading to medium greyish brown	
3	SS	25-19, 19-21	light grey m-f SAND, little Silt+Clay	
4	SS	16-16, 16-18		
5	SS	12-10, 11-10	light grey m-f SAND, trace Silt+Clay	
6	SS	5-15, 10-15	-tan+black staining	
7	SS	10-14, 21-41	tan f-m SAND, trace Silt+Clay	
8	SS	21-40, 92-100/4	-grading to greenish grey	
9	SS	25-30, 74-100/5		
10	SS	24-78, 100/5	tan f-m SAND, trace Silt+Clay	
11	SS	29-56, 100/6		
12	SS	40-100/6	light grey f-m SAND, trace Silt+Clay	
13	SS	15-33	light grey f-m SAND, little Silt; occ. black staining	

END OF BORING 25.0'

Depth scale (feet): 0, 5, 10, 15, 20, 25, 30, 35, 40, 45

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. B-1

SHEET NO. 1 OF 1
JOB NO. 02362217
ELEVATION 23.94
DATE STARTED 2/14/85
DATE FINISHED 2/15/85
DRILLER M. RYAN
INSPECTOR I. KLOTZSCH

PROJECT: CFC CHEMICAL
CLIENT: CFC CHEMICAL
BORING CONTRACTOR: KENDRICK DRILLING
GROUND WATER

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE	MUD	SS		
DIA.		2"		
WT.		140 lbs		
FALL		30"		

WELL CONSTRUCTION: CEMENT - BENTONITE GROUT (0–25 ft)

DEPTH (FEET)	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	HNU	REMARKS
0	S-1	SS	77-100/4	SOIL CEMENT 1.0'	17.8	
	S-2 A+B	SS	25-11, 8-11	black c-m-f SAND, little m-f-c Gravel, little- Silt + Clay	6.4/6.2	
5	S-3	SS	12-13, 17-20	yellowish tan to grey m-f GRAVEL, some+ f-m Sand, trace- Silt + Clay	3.0	
	S-4	SS	14-24, 33-32	orange f-m GRAVEL, some+ c-m-f Sand, trace Silt + Clay	3.8	
	S-5	SS	20-24, 26-32	- grading to m-f-c GRAVEL, some+ c-m-f Sand, trace Silt + Clay.	3.6	
10	S-6	SS	11-13, 19-22	yellowish grey f SAND	2.2	
	S-7	SS	16-20, 16-9	grey f SAND, little silt, trace Clay 13.0'	2.2	
15	S-8	SS	5-7, 13-13	dark grey CLAY, little Silt	7.4	
	S-9 A+B	SS	6-9, 16-78	- grading to dark grey CLAY + SILT 16.5'	8.6/3.8	
	S-10 A+B	SS	11-19, 41-100/5	yellowish tan f-m-c SAND, little- Silt + Clay 17.0'	11.4/3.2	
20	S-11	SS	16-44, 100/6	light greyish tan CLAY, little Silt 18.0'	4.8	
	S-12	SS	34-41, 51-44	light grey f-m SAND, trace Silt + Clay	9.4	
25	S-13	SS	8-15, 24-31	- grading to f-m SAND, trace- Silt; light grey, black, and tan f SAND, little- Silt 25.0'	4.7	

END OF BORING

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG
BORING NO. G-2

PROJECT: CCS CHEMICAL	SHEET NO. 1 OF 1
CLIENT: CCS CHEMICAL	JOB NO. 02366617
BORING CONTRACTOR: KENDRICK DRILLING	ELEVATION 24.57
GROUND WATER	DATE STARTED 6/5/82
	DATE FINISHED 6/5/82
	DRILLER M. RYAN
	INSPECTOR I. KLOTZSCH

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE		SS		
DIA.		2"		
WT.		140#		
FALL		30"		

WELL CONSTRUCTION	DEPTH IN FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
CEMENT - BENTONITE GROUT (0' to ~39')	0	1B / 1A	SS	4-10 / 10-11	medium to dark brown m-f-c SAND and c-m-f GRAVEL, little- Silt+Clay; at 1.3' - light brown to tan m-f SAND, little- Silt+Clay	
	5	2	SS	12-14 / 11-11	black c-m-f GRAVEL, some m-f Sand, little Silt+Clay	
		3	SS	11-10 / 9-10	medium brown - black m-f SAND, little Silt+Clay - greenish staining	
	10	4	SS	9-5 / 8-13		
		5	SS	9-5 / 10-13	olive green c-m SAND, little+ Silt+Clay occassional yellow staining	
		6	SS	6-10 / 15-13	15.0'	
	15	7B / 7A	SS	6-7 / 17-22	tan CLAY+SILT to SILT+CLAY 16.0'	
		8	SS	11-17 / 23-29	light tanish grey m-f SAND, little- Silt+Clay	
	20	9B / 9A	SS	9-10 / 7-9	20.5'	
		10	SS	5-22 / 36-100/6	tan CLAY+SILT to SILT+CLAY 21.0'; light grey f-m SAND, little Silt+Clay	
		11	SS	25-27 / 30-27		
	25					
		12	SS	24-35 / 46-52	light grey, tan, and black f-m SAND, little Silt+Clay	
	30					
		13	SS	100/5	grey f-m SAND, trace+ Silt	
	35					
		14	SS	37-100/5	light grey, tan, and black f-m SAND, little Silt+Clay 39.0'	
	40				END OF BORING	
	45					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. B-5

SHEET NO. 1 OF 1

PROJECT: CDS CHEMICAL

CLIENT: CDS CHEMICAL

BORING CONTRACTOR: KENDRICK DRILLING

JOB NO. 02262217

ELEVATION 22.41

DATE STARTED 31.1.83

DATE FINISHED 31.1.83

DRILLER M. RYAN

INSPECTOR I. KLOTZSCH

GROUND WATER

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE		SS		
DIA.		2"		
WT.		140 lbs		
FALL		30"		

WELL CONSTRUCTION	DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
CEMENT-BENTONITE GROUT	0	1A	SS	11-14 13-23	"SOIL CEMENT" FROM 0.0-0.5' dark brown+black f-m-c SAND, little Silt, trace+Clay medium grey f-m SAND, little Silt, trace Clay	
	5	2	SS	22-30 41-56	orange to tan m-c-f SAND little Silt+Clay	
	10	3	SS	17-27 22-41	tanish grey f-m SAND, little-Silt+Clay	
	15	4	SS	55-42 [illegible]	-grading to grey w/ orange and tan staining	
	20	5	SS	32-61 73-62	light grey f-m SAND, little Silt, trace Clay	
	25	6	SS	17-27 44-66	light grey f-m SAND, some Silt, little Clay 27.0'	
					END OF BORING	
	30					
	35					
	40					
	45					

SOURCE: CONVERSE 1984

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-1

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey
CLIENT Madison/CPS Industries
BORING CONTRACTOR Warren George

SHT. NO. 1 OF 1
PROJ. NO. 81-07188-06
ELEVATION
DATUM
DATE START 03/08/84
DATE FINISH 03/08/84
DRILLER R. Danielson
CWDO REP. KJL

GROUND WATER

DATE	TIME	DEPTH	CASING

	CAS.	SAMP.	CORE	TUBE
TYPE	F.J.			SHELBY
DIA.	4"			3"
WT.	140#			140#
FALL	24"			24"±

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION	REMARKS
					2.0' Water	
					A. Black Organic Silt, very soft	
1					B. do	
2					C. Black Sand w/ layers Organic Silt	pH=6.5, pond water Tube: 0-4.0' Rec.=24" Push
		S-1.			D. Black Peat & Organic Silt	
3						
4					A. Black Organic Silt	Tube: 4.0'-7.0' Rec.=36" Push & hammer
					B. do	
5					C. do w/ Peat	
					5.5'	
					D. Gray Sand, occasional gravel	
6		S-2			E. do	
					F. Tan Sand, medium fine	
7					END OF BORING @ 7.0'	
8						
9						On calibration, pH meter measured 7.8 instead of 6.9.
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-2

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey	SHT. NO. 1 OF 1
CLIENT Madison/CPS Industries	PROJ. NO. 81-07188-06
BORING CONTRACTOR Warren George	ELEVATION

GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE				SHELBY	DATE START 03/08/84
				DIA.				3"	DATE FINISH 03/08/84
				WT.				140#	DRILLER R. Danielson
				FALL				24"	CWOO REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION 7.5' Water	REMARKS
			P		A. Black Organic Silt & fine Sand 0.5	pH=5.8, pond water Tube: 0-3.5' Rec.=36"
1			P		B. Tan medium to fine Sand	
			P		C. do	
2		S-1	25		D. Yellow brown medium to fine Sand	
					E. do	
3			43		F. do	
					END OF BORING @ 3.5'	
4						
5						
6						
7						On calibration, pH meter measured 7.8 instead of 6.9.
8						
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-3

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey
CLIENT Madison/CPS Industries
BORING CONTRACTOR Warren George

SHT. NO.	1 OF 1
PROJ. NO.	81-07188-06
ELEVATION	
DATUM	
DATE START	03/12/84
DATE FINISH	03/12/84
DRILLER	R. Danielson
CWDD REP.	KJL

GROUND WATER					CAS.	SAMP.	CORE	TUBE
DATE	TIME	DEPTH	CASING	TYPE				SHELBY
-				DIA.				3"
				WT.				140#
				FALL				24"±

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	IDENTIFICATION 8.0' Water	REMARKS
				0.25±'	
			P	A. Black gray Silty Sand-3"±	Tube: 0-4.0' Rec.=44"
1				B. Gray Sand, medium fine, uniformly graded	
			16	C. do	
2		S-1		D. do	
			30	E. do	
3				F. do	
			25	G. do	
4				H. do	
				END OF BORING @ 4.0'	
5					
6					
7					
8					
9					
10					
11					

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-4

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey — SHT. NO. 1 OF 1

CLIENT Madison/CPS Industries — PROJ. NO. 81-07188-06

BORING CONTRACTOR Warren George — ELEVATION

GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE				SHELBY	DATE START 03/12/84
				DIA.				3"	DATE FINISH 03/12/84
				WT.				140#	DRILLER R. Danielson
				FALL				24"	CWDO REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION	REMARKS
					3.5' Water	
			P		0.5±'	
1					A. Black Organic SILT & Fibers, Weeds-6"±	Tube: 0-3.0' Rec.=NR, moved 2'± Tube: 0-5.0' Rec.=42"
			P		B. Gray Sand, piece Coarse Gravel	
2					C. do	
		S-1	11		D. Tan Sand, medium to fine	
3					E. do	
			21		F. do	
4			22		G. w/occasional black organic matter and clay laminations	
5					END OF BORING @ 5.0'	
6						
7						
8						
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-5

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey
CLIENT Madison/CPS Industries
BORING CONTRACTOR Warren George
GROUND WATER

SHT. NO. 1 OF 1
PROJ. NO. 81-07188-06
ELEVATION
DATUM
DATE START 03/12/84
DATE FINISH 03/12/84
DRILLER R. Danielson
CWDD REP. KJL

DATE	TIME	DEPTH	CASING		CAS.	SAMP.	CORE	TUBE
				TYPE				SHELBY
				DIA.				3"
				WT.				140#
				FALL				24"

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION 4.0' Water	REMARKS
					0.3±	
			P		A. Black Organic SILT & SAND-4"±	
1					B. Gray brown Sand, occasional pieces fine Gravel	pH=6.16, pond water Tube: 0-4.0' Rec.=47"
			6		C. do	
2		S-1			D. do	
			17		E. do	
3					F. Tan Sand, occasional clay laminations	
			20		G. do	
4					H. do	
					END OF BORING @ 4.0'	
5						
6						
7						On calibration, pH meter measured 7.8 instead of 6.9
8						
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-6

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey
CLIENT Madison/CPS Industries
BORING CONTRACTOR Warren George

SHT. NO. 1 OF1
PROJ. NO. 81-07188-06
ELEVATION
DATUM
DATE START 03/12/84
DATE FINISH 03/12/84
DRILLER R. Danielson
CWDD REP. KJL

GROUND WATER

DATE	TIME	DEPTH	CASING		CAS.	SAMP.	CORE	TUBE
				TYPE				SHELBY
				DIA.				3"
				WT.				140#
				FALL				30"

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION 7.0' Water	REMARKS
			P/6"		A. Black Organic Silt, less than 3" 0.25±	
1			4		B. Gray brown Sand	
					C. do	pH=5.69, pond water Tube: 0-4.0' Rec.=33" pp.=1.25TSF, D.
2		S-1	12		D. 2" thick layer Black Organic Silt, with orange brown stained sand	
3			24		E. Gray Sand, medium to fine	
4			10/6"		F. do	
					END OF BORING @ 4.0'	On calibration, pH meter measured 7.8 instead of 6.9.
5						
6						
7						
8						
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-7

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey — SHT. NO. 1 OF 1

CLIENT Madison/CPS Industries — PROJ. NO. 81-07188-06

BORING CONTRACTOR Warren George — ELEVATION

GROUND WATER					CAS.	SAMP.	CORE	TUBE	
DATE	TIME	DEPTH	CASING	TYPE				SHELBY	DATUM
				DIA.				3"	DATE START 03/15/84
				WT.				140#	DATE FINISH 03/15/84
				FALL				24"±	DRILLER R. Danielson
									CWDO REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION 2.0' Water	REMARKS
			P		A., B., Brown Organic SILT & Sand-6"± 0.5	
					C. Brown Sandy Gravel-3"± 0.8	
1						
			P		D. Gray brown Sand w/occasional orange brown sand layer	pH=6.78, pond water Tube: 0-5.0' Rec.=42"
					E. do	
2					F. do w/infrequent laminations, ½" thick, of Silty Clay	
		S-1	P		G. do	
3					H. do	
			22			
4						
			24			
5					END OF BORING @ 5.0'	
6						On calibration, pH meter measured 8.0 instead of 6.9.
7						
8						
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-8

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey	SHT. NO. 1 OF 1
CLIENT Madison/CPS Industries	PROJ. NO. 81-07188-06
BORING CONTRACTOR Warren George	ELEVATION

GROUND WATER					CAS.	SAMP.	CORE	TUBE	
DATE	TIME	DEPTH	CASING	TYPE				SHELBY	DATUM
				DIA.				3"	DATE START 03/15/84
				WT.				140#	DATE FINISH 03/15/84
				FALL				24"	DRILLER R. Danielson
									CWDD REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION 3.0' Water	REMARKS
					0.25	pH=8.0 frozen
			P/6"		A. Black Organic SILT-3" 0.5	Tube: 0-5.0' Rec.=48"
			3/6"		B. Brown Orange Sandy Gravel-3"	
1			1		C. Tan Sand	
2		S-1	4		D. do	
3			18		E. Gray Sand w occasional laminations SILTY CLAY	
4					F. do	
			30		G. do	
5					H. do	
					END OF BORING @ 5.0'	
6						
7						
8						
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-9

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey — SHT. NO. 1 OF 1
CLIENT Madison/CPS Industries — PROJ. NO. 81-07188-06
BORING CONTRACTOR Warren George — ELEVATION
GROUND WATER — DATUM

DATE	TIME	DEPTH	CASING		CAS.	SAMP.	CORE	TUBE	
				TYPE				SHELBY	DATE START 03/14/84
				DIA.				3"	DATE FINISH 03/14/84
				WT.				140#	DRILLER R. Danielson
				FALL				24"	CWOD REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION 5.0' Water	REMARKS
			P		A. Black Organic SILT-6" thick 0.5	
1			8		B. Brown Gravelly Sand	pH=6.88, pond water Tube: 0-5.0' Rec.=39"
2		S-1	7		C. Brown/Orange Sand	
3			5		D. Brown Gray Sand, occasional laminations (½"th.) Silty Clay, some orange staining	
4					E. do	
			6		F. do	
					G. do	
5					END OF BORING @ 5.0'	On calibration, pH meter measured 7.7 instead of 6.9.
6						
7						
8						
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-10

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey
CLIENT Madison/CPS Industries
BORING CONTRACTOR Warren George

GROUND WATER					CAS.	SAMP.	CORE	TUBE
DATE	TIME	DEPTH	CASING	TYPE				SHELBY
				DIA.				3"
				WT.				140#
				FALL				24"

SHT. NO. 1 OF1
PROJ. NO. 81-07188-06
ELEVATION
DATUM
DATE START 03/14/84
DATE FINISH 03/14/84
DRILLER R. Danielson
CWDD REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION	REMARKS
					2.0' Water	
			P		A. Black Organic SILT-6"	pH=6.55 pond water Tube: 0-5.0' Rec.=48"
1					B. Brown Sandy Gravel-9"±	
			4			
2		S-1	4		C. Gray Sand, occasional ½"thick laminations Silty Clay (orange brown staining on both sides of clay layer)	
3			13		D. do	
					E. do	
4					F. do	
			19		G. do	
5					H. do	
					END OF BORING @ 5.0'	On calibration, pH meter measured 7.7 instead of 6.9.
6						
7						
8						
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-11

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey

CLIENT Madison/CPS Industries

BORING CONTRACTOR Warren George

SHT. NO. 1 OF 1

PROJ. NO. 81-07188-06

ELEVATION

DATUM

DATE START 03/14/84

DATE FINISH 03/14/84

DRILLER R. Danielson

CWDO REP. KJL

GROUND WATER

DATE	TIME	DEPTH	CASING

	CAS.	SAMP.	CORE	TUBE
TYPE	F.J.			SHELBY
DIA.	4"			3"
WT.	140#			140#
FALL	24"			24"±

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION	REMARKS
					1.2' Water	
			P		A. Black Organic SILT & SAND	pH=6.61 Tube: 0-5.0' Rec.=42"
1	P					
			P		B. Gray Sand with Organic SILT	
2	P	S-1			C. do 2.0±'	
			6		D. Brown Sand, coarse to medium, with fine Gravel	
3	13				E. do	
			12		F. do and gravel (3" layer)	
4	14				G. Gray Sand, medium to fine	
			7			
5	20					
			P		A. Gray Sand, medium to fine w/occasional laminations w/Black Organic Silt	Tube: 5.0'-8.0' Rec.=24"
6		S-2			B. do	
			14		C. do with occasional laminations ½"-1½" thick	
7						
			16		D. do	Note: 2D-Gray Silty Clay
8					END OF BORING @ 8.0'	
9						On calibration, pH meter measured 7.6 instead of 6.9.
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-13
PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey		SHT. NO. 1 OF 1
CLIENT Madison/CPS Industries		PROJ. NO. 81-07188-06
BORING CONTRACTOR Warren George		ELEVATION

GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE				SHELBY	DATE START 03/14/84
				DIA.				3"	DATE FINISH 03/14/84
				WT.				140#	DRILLER R. Danielson
				FALL				24"	CWDD REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION	REMARKS
			P		A. Black Organic SILT, FIBERS-8"±	pH=7.2, pond water Tube: 0-5 Rec.=51"
					0.7	
1			P/6"		B. Brown Sandy Gravel	Sample D-Silty Clay
					C. do	
2		S-1	9		D. Orange brown Sand with occasional laminations of Silty Clay	
3			8		E. do	
					F. do	
4			18		G. Gray Sand, medium fine	
5			18/6"		H. do	
					END OF BORING @ 5.0'	Cleaned tube with methanol & water.
6						
7						On calibration, pH meter measured 7.7 instead of 6.9.
8						
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-14

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey — SHT. NO. 1 OF 1

CLIENT Madison/CPS Industries — PROJ. NO. 81-07188-06

BORING CONTRACTOR Warren George — ELEVATION

GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE	F.J.			SHELBY	DATE START 03/15/84
–				DIA.	4"			3"	DATE FINISH 03/15/84
				WT.	140#			140#	DRILLER R. Danielson
				FALL	24"			24"	CWDO REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION	REMARKS
					1.0' Water	
			P		A. Black Organic SILT, weeds-9"±	pH=7.9, pond water Tube: 0-5.0' Rec.=48"
					B. do 0.8±	
1	P					
			P		C. Brown Gravelly Sand-3"±	
2	P					
		S-1	3		D. Gray Sand	
3	P				E. do	
			6		F. Gray Sand occasional clay laminations, pocket brown sand	
4	24				G. do	
			12		H. do	
5	50				I. do	
			14		A. Gray Sand occasional laminations of Silty Clay ¼" thick, brown sand staining top & bottom	Tube: 5.0'-9.0' Rec.=27"
6						
			26		B. do	
7		S-2			C. do	
			22		D. do	
8					E. do	
			28		F. do	
9					END OF BORING @ 9.0'	On calibration, pH meter measured 7.8 instead of 6.9.
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-15

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey — SHT. NO. 1 OF

CLIENT Madison/CPS Industries — PROJ. NO. 81-07188-06

BORING CONTRACTOR Warren George — ELEVATION

GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE	F.J.			SHELBY	DATE START 03/15/84
				DIA.	4"			3"	DATE FINISH 03/15/84
				WT.	140#			140#	DRILLER R. Danielson
				FALL	24"			24"	CWDO REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION (1.5' Water)	REMARKS
			P		A. Black Organic SILT-9"±	pH=7.3, pond water Tube: 0-5.0' Rec.=30"
1					B. do w/Brown Gravelly Sand	
			P		C. Brown Gravelly Sand	
2			P/6"		D. Brown Sand	
		S-1				
3			4		E. do	
4			9			Probably lost 3.0'-5.0', therefor moved 2' west and started sampling @ 3.0'.
5			9/6"		CONTINUED - SEE LOG B-15A	
6						
7						
8						On calibration, pH meter measured 7.9 instead of 6.9
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-15A

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey — SHT. NO. 1 OF 1
CLIENT Madison/CPS Industries — PROJ. NO. 81-07188-06
BORING CONTRACTOR Warren George — ELEVATION
GROUND WATER — DATUM

DATE	TIME	DEPTH	CASING		CAS.	SAMP.	CORE	TUBE	
				TYPE	F.J.			SHELBY	DATE START 03/15/84
				DIA.	4"			3"	DATE FINISH 03/15/84
				WT.	140#			140#	DRILLER R. Danielson
				FALL	24"			24"	CWDD REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION	REMARKS
					1.5' Water	
1						
2						
3					3.0'	
			10		A. Gray brown Sand	Moved 2' West-set casing & washed. Tube: 3.0'-7.0' Rec.=30"
4			17		B. do w/ occasional laminations ¼" Silty Clay	
5		S-2			C. do	
			20		D. do	
6			25		E. do	
7					END OF BORING @ 7.0'	
8						
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO B-16

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey									SHT. NO. 1 OF 1
CLIENT Madison/CPS Industries									PROJ. NO. 81-07188-06
BORING CONTRACTOR Converse Consultants, Incorporated									ELEVATION
GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE				SHELBY	DATE START 03/16/84
		1.0	None	DIA.				3"	DATE FINISH 03/16/84
				WT.				40#	DRILLER WTM
				FALL				18"±	CWDD REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION	REMARKS
					A. Brown Sandy Gravel	
1					B. do	
					C. Gray Sand mixed with Organic SILT & FIBERS	
2		S-1			D. Black Organic SILT @ 24" down (3"± thk.)	Tube: 0-3.0' Rec.=30"
					E. Brown Gray Gravelly Sand	
3					A. Black gray Gravelly Sand (Trace Organic SILT)	
					B. do	
4		S-2			C. Brown Sand, trace Black Organic SILT 4.5"±	Tube: 0-5' Rec.=48"± (24"-from above)
					D. do (w/o Organic SILT)	
5					END OF BORING @ 5.0'	
6						
7						
8						
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-17

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey — SHT. NO. 1 OF 1

CLIENT Madison/CPS Industries — PROJ. NO. 81-07188-06

BORING CONTRACTOR Converse Consultants, Incorporated — ELEVATION

GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE				SHELBY	DATE START 03/16/84
				DIA.				3"	DATE FINISH 03/16/84
				WT.				40#	DRILLER WTM
				FALL				18"±	CWDD REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION	REMARKS
					A. Black Organic SILT & SAND 0.5±	
1					B. Brown Sandy Gravel, with occasional Black Organic SILT	
					C. do	Tube: 0-3.5' Rec.=42"± (densified to 30"±) Boring located near middle of stream bed.
2		S-1			D. do	
					E. do	
3						
					END OF BORING @ 3.5'	
4						
5						
6						
7						
8						
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-17A

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey	SHT. NO. 1 OF 1
CLIENT Madison/CPS Industries	PROJ. NO. 81-07188-06
BORING CONTRACTOR Converse Consultants	ELEVATION

GROUND WATER					CAS.	SAMP.	CORE	TUBE	
DATE	TIME	DEPTH	CASING	TYPE				SHELBY	DATUM
				DIA.				3"	DATE START 03/16/84
				WT.				40#	DATE FINISH 03/16/84
				FALL				18"±	DRILLER WTM
									CWDD REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION	REMARKS
1		S-1			A. Brown Sandy Gravel, w/ little Organic SILT B. Black gray Sand 1.5'±	Tube: 0-3.0' Rec.=33"
2					C. Brown Sand D. do E. Tan Gravelly Sand F. Tan Sand	Boring located near edge of stream bed.
3					END OF BORING @ 3.0'	
4						
5						
6						
7						
8						
9						
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-18

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey									SHT. NO. 1 OF 1
CLIENT Madison/CPS Industries									PROJ. NO. 81-07188-06
BORING CONTRACTOR Warren George									ELEVATION
GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE	F.J.			SHELBY	DATE START 03/16/84
-		1.0	None	DIA.	4"			3"	DATE FINISH 03/16/84
				WT.	140#			140#	DRILLER R. Danielson
				FALL	24"			24"±	CWOD REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION	REMARKS
			P		A. Brown Gray SILTY Sand	Boring located on delta, done with tripod rig on land.
1	P				B. do	
			6		C. Brown Black Sand	
2	4				D. do	
		S-1	9		E. Brown Sand, Gravel	Tube: 0-5.0' Rec.=48"
3	19				F. do	
			20		G. do	
4	35				H. do	
			25			
5	64					
			20		A. Gray Sand	
6					B. do	
		S-2	20		C. do w/clay laminations ¼" thick k	Tube: 5.0-9.0' Rec.=32"
7						
			[illegible]		D. do of Silty Clay, brown staining	
8						
			34			
9					E. do	
					END OF BORING @ 9.0'	
10						
11						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-19

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey	SHT. NO. 1 OF 1
CLIENT Madison/CPS Industries	PROJ. NO. 81-07188-06
BORING CONTRACTOR Converse Consultants, Incorporated	ELEVATION

GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE				SHELBY	DATE START 03/16/84
				DIA.				3"	DATE FINISH 03/16/84
				WT.				40#	DRILLER WTM
				FALL				18"±	CWDD REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION	REMARKS
					A. Brown Gravelly Sand	Tube: 0-5.0' Rec.=46"±(densified to 36" prior to pulling tube)
1					B. do	
2		S-1			C. Gray orange brown Sand w/ laminations Black Gray Silty Clay	
3					D. do	
					E. do	
4					F. do	
5					END OF BORING @ 5.0'	
6						
7						
8						
9						
10						

Converse Consultants, Inc.	TEST BORING LOG	BORING NO. B-20

PROJECT Prickett's Pond Sampling, Old Bridge, New Jersey	SHT. NO. 1 OF 1
CLIENT Madison/CPS Industries	PROJ. NO. 81-07188-06
BORING CONTRACTOR Converse Consultants, Incorporated	ELEVATION

GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE				SHELBY	DATE START 03/16/84
				DIA.				3"	DATE FINISH 03/16/84
				WT.				40#	DRILLER WTM
				FALL				18"	CWDD REP. KJL

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON TUBE PER 12"	SYMBOL	IDENTIFICATION	REMARKS
					A. Brown Sand, w/ leaves	
1		S-1			B. do	
					1.7'	
2					C. Black PEAT D. do E. do 2.5'	Tube: 0-4.0' Rec.=38"
3					F. Brown Black Silty Sand, (silt probably organic)	
4					END OF BORING @ 4.0'	
5						
6						
7						
8						
9						
10						
11						

OR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT, OF WHICH THIS LOG IS A PART.

SOURCE: WEHRAN 1986

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG
BORING NO. E-[illegible]
SHEET NO. 2 OF 3
JOB NO. [illegible]

PROJECT: SOUTH AMBOY FIRE-[illegible] EVALUATION
CLIENT: [illegible] CHEMICALS - MADISON INDUSTRIES

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	45	10	SS	41 61 / 100/5	SAND - [illegible], red; [illegible]	
	50	11	SS	40 100/5	do.	
	55	12	SS	15 20 / 25 36	SAND - [illegible] grey; trace [illegible] clay [illegible]	
	60	13	SS	25 66 / 57 85	SILT & CLAY - grey, [illegible]	
	65	14	SS	28 41 / 52 100/5	CLAY - dark grey, [illegible]	
	70	15	SS	36 100/5	SILT & CLAY	
	75	16	SS	20 32 / 47 89	do.	
					---- [illegible] ---- SAND	
	80	17	SS	37 62 / 100 100/4	fn-m, grey	
	85	18	SS	30 50 / 100/5	fn-m, yellow-grey; [illegible]	
		19	SS	20 38 / 58 57	fn-m [illegible]	
	90	20	SS	19 39 / 28 35	m-c, white; clay [illegible]	
		21	SS	36 28 / 50 68	[illegible]	
		22	SS	46 48 / 47 58	do.	
	95	23	SS	25 70 / 100 100	[illegible] thin [illegible]	

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. [illegible]
SHEET NO. [illegible] OF [illegible]
JOB NO. [illegible]

PROJECT : [illegible] FIRE-CLAY EVALUATION
CLIENT : [illegible] CHEMICALS - MADISON INDUSTRIES

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
CEMENT BENTONITE GROUT to SURFACE		23	SS	25 70 / 100 100	SAND - [illegible]	
		24	SS	42 95 / 72 72		
	79.3	25	SS	30 44 / 44 60	CLAY & SILT - dark grey (charcoal), [illegible] pyrite	
		26	SS	25 46 / 42 47	do	
		27	SS	22 28 / 23 67	do	
		28	SHELBY	PRESS	SILT - [illegible]	
		29	SHELBY	PRESS	[illegible]	
		30	SS	14 26 / 36 68	do	
		31	SS	19 29 / 35 52	do	
		32	SS	12 20 / 38 46	do	
		33	SS	13 21 / 26 44	do	
		34	SS	13 49 / 52 99	SILT - grey, trace [illegible]	
		35	SS	24 34 / 52 66	SILT - dark grey (charcoal), trace [illegible]	
		36	SS	72 74 / 100/3	SAND - dark grey (charcoal), trace [illegible]	
		37	SS	21 77 / 66 79	SAND - [illegible]	
	133				CLAY	
		38	SS	26 44 / 49 100/4	blue-grey, dense	
	146.0	39	SS	31 100/5	laminated, dense	
					END OF BORING	

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. [illegible]

SHEET NO. 1 OF 3

JOB NO. C6326

ELEVATION

DATE STARTED [illegible]

DATE FINISHED [illegible]

DRILLER [illegible]

INSPECTOR [illegible]

PROJECT: SOUTH AMBOY FIRE-CLAY EVALUATION

CLIENT: CPS CHEMICAL - MADISON INDUSTRIES

BORING CONTRACTOR: KENDRICK DRILLING

GROUND WATER

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE	[illegible]	[illegible]		[illegible]
DIA.	[illegible]"	2"		
WT.		140 lb.		
FALL		30"		

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0	1	SS	3 12 / 12 7	SAND - [illegible]	
	5					
	10					
	15					
	20					
	25					
	30					
	35					
	40					
	45					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. [illegible]

PROJECT: South Amboy Fire-Clay Evaluation

CLIENT: [illegible] – Madison Industries

SHEET NO. [illegible] OF [illegible]

JOB NO. [illegible]

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	45					
	50	2	SS	49 46 / 67 60	SAND - m-c, tan [illegible]	
	55					
	60	3	SS	60 100/5	SAND m-c, tan, [illegible]	
	65					
	70	4	SS	84 100/4	SAND m-c, tan [illegible]	
	75				79'	
	80	5	SS	17 33 / 54 53	CLAY - grey, trace [illegible]	
		6	SS	26 43 / 55 73	do	
	85	7	SS	23 23 / 27 23	SAND - m-c, tan	
		8	SS	19 38 / 54 56	do	
		9	SS	16 26 / 45 50	do - white clay [illegible]	
	90	10	SS	31 54 / 5[illegible] 77	SILT to SILT & CLAY - dark grey [illegible]	
		11	SS	[illegible] 5[illegible] / 100/.5	SILT - dark grey (charcoal), trace [illegible] lignite pyrite	SAMPLE 11: SPOON DRIVEN REMAINING 5" USING 300 LB. HAMMER
	95	12	SS	24 5[illegible] / 100/.4	SAND [illegible] partings, clay [illegible]	SAMPLE 12: do.
		13	SS	46 100/5	do	SAMPLE 13: SPOON DRIVEN REMAINING 12" USING 300 LB. HAMMER

WEHRAN ENGINEERING
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TEST BORING LOG
BORING NO. [illegible]

PROJECT : [illegible] FIRE-CLAY EVALUATION
SHEET NO. [illegible] OF [illegible]
CLIENT : [illegible] CHEMICALS – MADISON INDUSTRIES
JOB NO. [illegible]

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	95	12	SS			
		13	SS	76 100/3	SAND - [illegible]	
		14	SS	[illegible] / 73 04	SILT & [illegible] - [illegible] lignite, pyrite	
	100	15	SHELBY	PRES.	do	
		16	SHELBY	PRESS	do	
		17	SS	9 24 / 50 75		
	105	18	SS	14 27 / 55 75	SILT - grey, [illegible]	
	110	19	SS	20 32 / 44 60	SILT - grey, trace Sand, [illegible]	
	115	20	SS	21 34 / 80 100/3	SILT - grey, stiff, trace Sand, clay partings, [illegible]	
	120	21	SS	16 24 / 30 100/4	SILT - grey, trace Sand 122.0	
					END OF BORING.	
	125					
	130					
	135					
	140					
	145					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. [illegible]

PROJECT: SOUTH AMBOY FIRE-CLAY EVALUATION

CLIENT: CPS CHEMICAL - MADISON INDUSTRIES

BORING CONTRACTOR: KENDRICK DRILLING

SHEET NO. 1 OF [illegible]

JOB NO. [illegible]

ELEVATION

DATE STARTED [illegible]

DATE FINISHED [illegible]

DRILLER [illegible]

INSPECTOR [illegible]

GROUND WATER

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE	[illegible]	[illegible]		[illegible]
DIA.	4"	2"		
WT.		140 lb.		
FALL		30"		

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0	1	SS	2 7 / 10 15	SAND - [illegible]	
	5					
	10					
	15					
	20					
	25					
	30					
	35					
	40					
	45					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. [illegible]

SHEET NO. [illegible] OF [illegible]

JOB NO. [illegible]

PROJECT: SOUTH AMBOY [illegible] CLAY EVALUATION

CLIENT: [illegible] CHEMICALS – MADISON INDUSTRIES

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	45					
	50	2	SS	14 30 / 31 37	SAND - f., grey [illegible]	
	55	3	SS	12 21 / 21 25	do	
	60	4	SS	12 28 / 31 32	SAND f[illegible] tan, [illegible]	
	65	5	SS	22 34 / 43 57	do	
	70					
	75	6	SS	29 76 / 100/5	SAND - m-c, tan, [illegible]	
	80	7	SS	65 100/3	SAND - [illegible] tan - [illegible]	SAMPLE 7: SPOON DRIVEN REMAINING 15" USING 300 lb. HAMMER
					82.5	
					CLAY - tan	based on
	85	8	SS	80 100/5	SAND - m-c, yellow lignite	SAMPLE 8: SPOON DRIVEN REMAINING 13" USING 300 lb. HAMMER
	90					
					92'	
					CLAY - grey	based on
	95	9	SS	25 27 / 66 100/4	SAND - m-c dark grey (charcoal); clay [illegible] silt part[illegible] lignite	

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. [illegible]

PROJECT: [illegible]
CLIENT: [illegible]
SHEET NO. 3 OF 3
JOB NO. [illegible]

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	95	9	SS	25 27 / [illegible] 100/4	SAND - [illegible]	
		10	SS	43 100/5	do	Sample 10 spoon [illegible]
	100	11	SS	20 37 / 100/5	CLAY - dark grey (charcoal), [illegible]	
		12	SHELBY	PRESS		
		13	SHELBY	PRESS		
	105	14	SS	21 52 100/4	SILT - dark grey [illegible]	
		15	SS	24 45 / 71 100/5	do	
		16	SS	16 33 / 65 100/5	do	
	110	17	SS	14 20 / 35 62	do	
	115	18	SS	20 33 / 68 100/4	CLAY & SILT - dark grey [illegible]	
	120	19	SS	25 100	do	Sample 19 spoon [illegible]
	125	20	SS	19 34 / 52 100/3	SILT - dark grey (charcoal), [illegible] laminated, trace [illegible]	
	130	21	SS	40 100/5	SILT & CLAY - dark gray [illegible]	Sample 21: spoon [illegible]
	135	22	SS	33 60 / 100/3	do	
	140	23	SS	37 83 / 100/2	SILT & CLAY - dark grey [illegible], sand [illegible]	
	145	24	SS	3- 55 / 100/5	do 146.5 END OF BORING	

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CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. [illegible]

SHEET NO. 1 OF 2

JOB NO. [illegible]

ELEVATION [illegible]

DATE STARTED [illegible]

DATE FINISHED [illegible]

DRILLER [illegible]

INSPECTOR [illegible]

PROJECT: CPS CHEMICAL

CLIENT: CPS CHEMICAL

BORING CONTRACTOR: KENDRICK DRILLING

GROUND WATER

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE	[illegible]	SS		
DIA.		2"		
WT.		140 lbs.		
FALL		30"		

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	HNU	REMARKS
[illegible] GROUT	0	S-1 A+B	SS	22-19, 20-7	dark brown + black f-m-c SAND and c-m-f GRAVEL, little+ silt + clay	1.4/1.4	
		S-2 A,B +C	SS	1-7, 8-6	grey, black + tan f-m SAND, some Silt, trace+ Clay	1.8, 1.9/3.7	
	5	S-3	SS	12-17, 18-13	tan f-m SAND, little Silt, trace Clay	2.2	
		S-4	SS	18-21, 21-19	tan + orange m-f-c SAND, some f-m Gravel, little silt, trace+ clay	2.1	
		S-5 A+B	SS	22-27, 36-20		2.8/2.1	
	10	S-6 A+B	SS	36-35, 42-19	orange f-m GRAVEL, some+ c-m-f sand, little- silt	4.3/10.6	
		S-7 A+B	SS	27-39, 36-13	tan m-f SAND, trace silt	7.8/14.5	
	15	S-8	SS	10-12		5.2	
		S-9	SS	22-13, 19-24		2.4	
		S-10	SS	10-10, 8-14		3.4	
	20	S-11	SS	13-12, 21-23		2.6	
		S-12	SS	16-17, 25-21		2.6	
		S-13 A+B	SS	9-11, 17-17	- grading to f-m SAND, trace+ silt	5.0/2.5	
	25	S-14	SS	11-16, 27-36		2.2	
		S-15	SS	17-40, 45-36	occassional black, grey, yellow, orange, and reddish orange staining	2.6	
	30	S-16	SS	10-11, 16-18		2.5	
		S-17	SS	7-8, 10-11		2.0	
	35	S-18	SS	11-15, 26-39		2.6	
		S-19	SS	12-14, 14-23		3.5	
		S-20	SS	15-22, 68-100/5"		2.8	
	40	S-21	SS	100/5"		4.6	
		S-22	SS	22-24, 18-22		5.4	
	45	S-23	SS	6-6, 8-18		5.3	
		S-24	SS	13-14, 22-40		5.4	

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG
BORING NO. (BORING) WE-

PROJECT: CPS CHEMICAL
CLIENT: CPS CHEMICAL
SHEET NO. 2 OF 2
JOB NO.

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	HNU	REMARKS
CEMENT - BENTONITE GROUT	45			10-14			
		S-24	SS	20-40		5.4	
				29-66			
		S-25	SS	53-100/6		3.2	
				16-33			
	50	S-26	SS	38-48		3.6	
				28-41			
		S-27	SS	57-50		4.2	
				31-42			
		S-28	SS	100/5		5.0	
	55			20-31			
		S-29	SS	34-40		3.6	
		S-30		24-34	dark grey f SAND and SILT, trace Clay		
		A+B	SS	70-100/5	- grading to SILT + f SAND, little Clay	6.2/4.3	
		S-31		26-40			
	60	A+B	SS	44-90	61.0'	2.4/6.8	
				15-28	dark grey CLAY + SILT		
		S-32	SS	42-79		5.2	
				26-32			
	65	S-33	SS	72-90	- grading to dark grey CLAY, little Silt	4.6	
				24-57			
		S-34	SS	57-74		3.8	
		S-35		24-38	- occassional wood		
		A+B	SS	65-100/5		5.0/3.4	
				27-52			
	70	S-36	SS	72-100/3	71.5'	2.2	
				30-100/5	tan m-c-f SAND, trace Silt		
		S-37	SS			4.0	
				100/5	grey c-m-f SAND, trace Silt		
		S-38	SS		75.0'	5.2	
	75				END OF BORING		
	80						
	85						
	90						
	95						

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. WE-2 ([illegible])

SHEET NO. 1 OF 2

JOB NO. [illegible]

ELEVATION [illegible]

DATE STARTED [illegible]

DATE FINISHED [illegible]

DRILLER [illegible]

INSPECTOR [illegible]

PROJECT: CPS CHEMICAL

CLIENT: CPS CHEMICAL

BORING CONTRACTOR: HENDRICK DRILLING

GROUND WATER

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE	[illegible]	SS		
DIA.		2		
WT.		140 lbs		
FALL		30"		

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
CEMENT - BENTONITE GROUT	0	S-1	SS	1-5, 5-8	dark brownish black f-m-c SAND, little+ Silt+Clay, trace f-m Gravel	
		S-2	SS	15-13, 15-19	dark brownish black f-m-c SAND, little Silt+Clay	
	5	S-3	SS	9-13, 20-25		
		S-4	SS	19-24, 23-32	tan f-m SAND, trace+ Silt; brown staining at 7.6'	
		S-5	SS	14-15, 16-18	- grading to light brown 10.0'	
	10	S-6 A+B	SS	7-5, 14-16	tan SILT+CLAY, little+ f Sand 11.5'	
		S-7	SS	10-16, 19-28	greyish tan f-m SAND, trace+ Silt	
	15	S-8	SS	10-22, 22-16	tan f-m SAND, little Silt - grading to grey 16.0'	
		S-9 A+B	SS	5-16, 24-35	tanish grey SILT, some Clay 16.7' grey f-m SAND, trace+ Silt	
	20	S-10	SS	14-16, 21-27	grey f-m SAND, some- Silt	
		S-11	SS	14-11, 14-35	- grading to medium brown	
		S-12	SS	12-18, 36-100/6	tan to grey f-m SAND, little Silt+Clay	
	25	S-13	SS	28-43, 65-100/3	grey f-m SAND, trace+ Silt	
	30	S-14	SS	8-13, 18-22	dark brown+black f-m SAND, little- Silt	
	35	S-15	SS	4-13, 43-74	light grey f-m SAND, little- Silt	
	40	S-16 A+B	SS	26-29, 27-33	- grading to some- Silt at 40.5' grey very f SAND, little Silt	
	45	S-17	SS	13-21, 34-43	light grey f-m SAND, little+ Silt	

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. [illegible]

SHEET NO. 2 OF 2

JOB NO. [illegible]

PROJECT: CPS CHEMICAL

CLIENT: CPS CHEMICAL

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
[illegible]	45	S-17	SS	12-21 / 24-40		
	50	S-18	SS	21-42 / 52-76	greyish tan m-f-c SAND, trace Silt (52.3')	
		S-19 A,B C-D	SS	23-23 / 34-86	grey + tan SILT + CLAY to CLAY + SILT (54.0')	
	55				tan + grey m-f SAND, trace Silt	
	60	S-20	SS	39-22 / 26-23	grey + tan m-f SAND, little Silt + Clay	
	65	S-21	SS	91-100/5	tan + grey f-m SAND, trace Silt	
	70	S-22	SS	76-100/3	grey to tan m-c-f SAND; orange staining	
	75	S-23	SS	41-41 / 52-59	- cream, red, and yellow staining (76.7')	
					END OF BORING	
	80					
	85					
	90					
	95					

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. [illegible]
ELEVATION
DATE STARTED [illegible]
DATE FINISHED August [illegible]

PROJECT CPS-Madison PURPOSE Boring
LOCATION WATER LEVEL DATE TIME
TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST -

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
5								
10					17 8 9 11		6" yellow f. sand w/ streak of lignite. 7" yellow med. sand.	13" sample - 6' fill
15								
20					5 17 22 31		Top - gray c. sand w/ gravel. balance - gray f. to med. sand.	13" sample
25								
30					14 17 16 18		Top 1" Tan clay c. sand. balance - Tan f. sand w/ mica & bottom 1½" is gray	8" sample
35								

SCREEN SET FROM ______ TO ______ SHEET 1 OF 2

...ENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
...EAU OF GROUND WATER MANAGEMENT

BORING NO. 5 + 65
ELEVATION ______
DATE STARTED ______
DATE FINISHED ______

PROJECT ______ PURPOSE ______

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
					11 20 17 17		3" gray C. to med. clayey sand. 1" white clay 6" gray med. sand ½" white clay w/iron-stone balance - gray f. to med. sand.	15½" sample
5								
50					7 9 11 15		gray silty clay	16½" sample
55					5 9 13 17		4" gray silty clay balance - gray clay w/Tr. lignite	16" sample
60					4 9 12 15		gray clay w/Tr. lignite Note sealed hole with 2 bags cement and 1 bag bentonite	12" sample
5								
0								
5								

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SCREEN SET FROM ______ TO ______

SHEET 2 OF 2

... OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. 2 + 07.11'
ELEVATION
DATE STARTED August [illegible]
DATE FINISHED August 21, [illegible]

PROJECT CPS-Madison PURPOSE Boring
LOCATION WATER LEVEL DATE TIME

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST -

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
20					6 2 12 24		5" dk Br. f. sand w/streak Tan med sand & gravel balance = gray f. sand - Note auger settled 5" to 10"	24" sample
					3 5 5 4		small ball of white clay and gravel	lost sample
					4 8 6 7		gray silty f. sand w/tan sand and streaks of tan & gray clay	-

A-119

SCREEN SET FROM ______ TO ______ SHEET 1 OF 2

... OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. 2 + 37.25'
ELEVATION
DATE STARTED
DATE FINISHED

PROJECT ______ PURPOSE ______
LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______
TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
60'					5 10 14 19		gray clay w/sand on outside of sample	sealed with 2 bag cement and ½ bag bentonite

A-120

SCREEN SET FROM ______ TO ______

SHEET 2 OF 2

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. [illegible] - 5
ELEVATION
DATE STARTED June 22, [illegible]
DATE FINISHED June 23, [illegible]

PROJECT CPS-Madison PURPOSE Boring
LOCATION WATER LEVEL DATE TIME

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran, Ryan INSPECTOR OR GEOLOGIST [illegible]

DEPTH	ELEVATION	CASING BLOWS/ FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
25								No samples just log. massive clay at 7[illegible] sealed w/2 bags cement and 1 bag Bentonite
50								
75								
75.5								
0								
5								
0								
5								

A-121

SCREEN [illegible] FROM ______ TO ______

SHEET 1 OF 1

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. 5 - 55'7"
ELEVATION
DATE STARTED June 14, 1982
DATE FINISHED June 15, 1982

PROJECT CPS-Madison PURPOSE Boring
LOCATION WATER LEVEL DATE TIME
TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST Dalton

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	TYPE SS	SPOON BLOW 6" PENE.				WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
5			#1		10	18	16	14		Mottled tan to gray silt w/Tr. of or silt in middle - Top 2" br. silt w/gravel.	17" sample
10			#2		21	9	11	12		Top 9" Br. v.f. silty sand w/some gravel 1" Or. v.f. sand 6" tan v.f. sand 1" or. v.f. sand 5" tan v.f. sand w/ streaks of lignite	20½" sample 3" fill in auger
15			#3		1 for 12"		6	12		1½" gray clay the rest tan f to med. sand w/ streaks of lignite	12" sample
20			#4		6	8	15	21		Top 10" or. tan f. to med sand w/streak of clay at bottom. middle 5" - layers of or. & gray f. to med. sand w/ ½" layers of lignite. bottom 6" - gray f. to med. sand w/ 2" layer of lignite at bottom	23" sample 6" fill in auger
25			#5		7	14	15	36			
30			#6		7	23	27	30		chocolate gray layered clay w/c. silt t. vf sand beds vary ½" to several inches.	
35			#7		16	24	26	59		Top 8½" mottled gray clay w/br - gray v.f. to f. sand bottom 9½" gray v f sand Tr. - lignite	18" sample

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SCREEN SET FROM ______ TO ______

See Next Page

DIVISION OF WATER ...
...EAU OF GROUND WATER MANAGEMENT

ELEVATION ______
DATE STARTED 5+95'7"
DATE FINISHED ______

...OJECT ______ PURPOSE ______

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
			#8		17 41 53 53		Top 1½" gray clay w/ silt to vf sand layers bottom 12½" gray white vf sand Tr. lignite	14" sample
5					12 25 19 21		gray white f. sand w/ ¼" or - yel. seam 1½" from bottom below is white f. sand + Tr clay	14" sample
								lost sample
50			#9		3 5 8 10		Top 4½" gray f to med sand w/clots of clay bottom - layered white & yel. or. f. clayey sand w/layer of lignite 2" up from bottom	
5					9 11 19 25			lost sample
60							washed f. to med white sand	No sample tried since ± 3 ft sand in auger
5							washed f to vc white sand	No sample tried ±3 ft sand in auger - take ± 20 gpm
70			#10		24 33 27 28		Top 2" gray white f to vc sand w/white clay clots middle - light gray f clayey sand w/ clay to clayey sand in middle. Bottom ... gray vf to f sand Tr clay	17" sample
5			#11		11 21 22 34		Top 14" or clayey f to c sand w/clot of yel-white clay Bottom 12½" mottled gray to bl gray dry clay w/several clots of gray f clayey sand ...	1?" sample ... 5½" fill ... fill in auger
73			#12					

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SCREEN SET FROM ______ TO ______

See Next Page SHEET 2 OF 3

SCREEN SET FROM ______ TO ______ SHEET 3 OF 3

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. 3 - 95'7"
ELEVATION
DATE STARTED
DATE FINISHED

PROJECT ______ PURPOSE ______
LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______
TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEV-ATION	CASING BLOWS/ FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
							Mottled gray-white clay w/Tr. bl gray clay Note sealed bottom of hole w/bentonite cement slurry 2½ bags cement and ½ bag bentonite	13" sample

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SCREEN SET FROM ______ TO ______

SHEET 3 OF 3

[illegible] OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. 5 - 03

ELEVATION

DATE STARTED June 16, [illegible]

DATE FINISHED June 21, [illegible]

PROJECT CPS-Madison PURPOSE Boring

LOCATION WATER LEVEL 6.95' DATE 6/21 TIME [illegible]

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST [illegible]

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	TYPE SS	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
0–5							Top 10½" or. silty gravel w/layers of dark olive br. silty sand & white silty vf sand 1" or. silty sand w/clay layers 1½" tan to white vf to f sand	13" sample
5			#1		7 6 7 10			
10			#2		15 15 15 24		gray to or. tan vf to f sand w/streak of lignite 6" from bottom	15" sample w/6½" fill
15			#3		17 33 37 35		Top-several gravel stones & ½" ironstone layer 5" gray vf to f sand 6½" tan & gray vf to f sand rest-or. vf to f silty sand	15" sample
20			#4		4 8 7 7		Top-several gravel stones 3" tan med to c silty sand w/streak of lignite bottom-gray med sand w/chocolate, or. & gray silty sand at base	11½" sample
25			#6		3 11 13 23		Top-Tr tan f clayey sand w/f gravel 9" tan f to med sand w/or streak & Tr lignite 2" or. f to med sand w/ streak ironstone bottom tan vf sand	15" sample
30			#7		4 9 14 18		Top 3"-Tan f to med sand Bottom 5" layered or. & gray f to med sand w/ 1" layer of lignite in middle, silty at base	8" sample
35					9 11 12 17		Some chips of lignite in spoon	Lost sample

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SCREEN SET FROM ________ TO ________

SHEET 1 OF 2

[illegible] OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. ____________
ELEVATION 8.05
DATE STARTED ____________
DATE FINISHED ____________

PROJECT ____________ PURPOSE ____________

LOCATION ____________ WATER LEVEL ____________ DATE ____________ TIME ____________

TYPE OF DRILLING ____________ DRILLER ____________ HELPER ____________ INSPECTOR OR GEOLOGIST ____________

DEPTH	ELEV-ATION	CASING BLOWS/ FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ____	REMARKS
			#9		6 11 12 12		Top 4" gray vf sand lignite Bottom 3" layered or., gray white & yellow to or. silty vf sand w/lignite at top	7" sample
5			#10		6 9 10 10		Top 6" light gray med - c sand w/clots of white clay Bottom 6" gray to tan to or. vf sand w/clots of oranish gray clay at top	12" sample
50					44 33			Lost sample
5			#11		10 23 30 41		Top 3" gray vf to c sand Bottom 13" layered gray, light gray, tan & or. vf to f sand	16" sample
60			#12		27 31 45 56		light gray vf to f sand w/streaks of gray, yellow & v dark gray w/ top coarse & bottom silty	15" sample w/5" of fill
5			#13		32 48 58 60		layered light gray & yellow med to c clayey sand w/layers ½" to 3" thick	w/ 9" fill
70			#14		43 81		Tanish gray clay & gravel mix	1" sample not split
5			#15		30 46 43 26		Top 5" tanish gray clay w/silt layers 7" tanish gray vf sand 12" or. vf sand becoming silty near bottom	24" sample

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SCREEN SET FROM ________ TO ________

SHEET 2 OF 3

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. 8 + 65
ELEVATION
DATE STARTED
DATE FINISHED

PROJECT ______ PURPOSE ______
LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______
TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.				WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
			#16		21	36	50	60		Tanish gray to whitish gray mottled clay w/ bluish or blackish specks	24" sample
5											
										Seal w/2 bags cement and ½ bag bentonite	
0											
5											
0											
5											
0											
5											

A-127

SCREEN SET FROM ... TO ...

SHEET 2 OF 2

BUREAU OF GROUND WATER MANAGEMENT

ELEVATION 10+41

DATE STARTED June 9, 1982

PROJECT CPS-Madison PURPOSE Boring DATE FINISHED June 10, 1982

LOCATION WATER LEVEL DATE TIME

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST Dalton

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
10			#1		14 5 6 6		Top 2½" or. silty clay lower 12½" layered or. & gray vf sand & mica	19" sample but 3" of it was fill in auger
20			#2		8 37 56 68		Top 6" gray vf sand 1" layer of or. gravel lower 10" mottled tan & gray vf sand - lignite throughout	19" sample
30					5 6 16 12			Lost sample
40								

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SCREEN SET FROM TO

SHEET 1 OF 3

[illegible] OF GROUND WATER [illegible]

[illegible] 10+41

DATE STARTED ______

PROJECT ______ PURPOSE ______ DATE FINISHED ______

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
40					3 / 19 / 19 / 20		light gray vf sand w/ knots of clay at the top and clayey sand layers in the middle several lignite layers	12" sample
50					10 / 10 / 14 / 26		Tan and gray vf to f silty to clayey sand w/ gravel at top heavy lignite seam in middle	5" sample
55					2 / 2 / 21 / 37			Lost sample
60					11 / 19 / 22 / 27		Top-Tan m to c sand Middle-dr tan f to m sand w/streak of lig-nite (1½") gray f to m sand w/ streaks of ironstone & lignite (1¼") Lower-2" or. f to m clayey sand	15" sample
								No sample taken-flowing sand
70					- / - / - / -		Top-5" gray to or. br. m to c sand 2" or. to white clay w/f gravel 17" or., gray y or. & white vf to f sand w/ white clay streak at 10" & bottom, Note the lower 14" has a clayey matrix	23" sample

SCREEN SET FROM ______ TO ______

DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. 10 + 41.7
ELEVATION
DATE STARTED
DATE FINISHED

PROJECT ______ PURPOSE ______
LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______
TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
9 – 10					14 / 40 / 56 / 60		dense gray br clay lower 4" mottled gray to white gravelly clay Note sealed hole w/heavy bentonite slurry to surface	15" sample

BUREAU OF GROUND WATER MANAGEMENT

ELEVATION 13+49

DATE STARTED June 7, 19[illegible]

PROJECT CPS-Madison PURPOSE Boring DATE FINISHED June 8, 19[illegible]

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST Dalton

DEPTH	ELEV-ATION	CASING BLOWS/ FOOT	SAMPLE NO.	TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
5								
10					6 4 12 9		Tan f sand w/streaks of y gray f sand w/½" gravel & stone at bottom	
5								
20					3 9 10 17		gravel & stone in a gray f sand w/2" gray clay at top & the bottom has streaks of gray silt	13½" sample
5					9 17 30 35		Top-gray f sand w/ stone Middle 3" gray clay Bottom gray f sand	16" sample
30					14 28 32 56		Top 6½" gray vf to f silty sand w/stone at top Middle-gray vf to f sand w/½" gray clay Bottom-gray clay sand	
5								
40								

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SCREEN SET FROM ______ TO ______

SHEET 1 OF 2

BUREAU OF GROUND WATER MANAGEMENT

ELEVATION 13+49

DATE STARTED ______

PROJECT ______ PURPOSE ______ DATE FINISHED ______

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
					18 / 20 / 27 / 47		dk gray vf to m sand w/dirty br silt or clay-Some lignite layers Tr gravel (stone) Note one black frg of crushed stone	
5								
50					7 / 13 / 13 / 16		gray vf to f clayey sand w/large mica flakes bottom 2" is br gray clayey sand to sandy clay	16½" sample
5								
60					25 / 50 / 62 / 47		Top 3" tan & or br vf to f sand w/some m sand and some silt lower 1½" gray silty clay	4½" sample
5					60 / 64		Top 9" tan m to c sand at 9" a ¼" bk & rust layer bottom 6" y or. f to c silty sand	15" sample +9" fill in auger
70								
5					28 / 46 / 47 / 49		Top 12" Tan and white m to c sand bottom-6" or. m to c sand Tr silt or clay	18" sample +9" fill in auger

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______ SCREEN SET FROM ______ TO ______

SHEET 2 OF 3

BUREAU OF GROUND WATER MANAGEMENT

ELEVATION 13+49

DATE STARTED

PROJECT ______ PURPOSE ______ DATE FINISHED

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
90					26 / 42 / 36 / 33		Top- 3" lt gray c sand 3" lt gray f clayey sand 2" lt gray c sand Lower 16" is a lt gray f silty to clayey sand and w/bedding distorted - thin layers of lignite	24" sample +4" fill in auger
5								
0								Sealed hole from 60' to surface w/ heavy bentonite slurry Note the gravel & stone mentioned in samples is foreign
5								
0								
5								

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SCREEN SET FROM ______ TO ______ SHEET 3 OF 3

16+5

DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

ELEVATION ______

DATE STARTED June 1, 1982

DATE FINISHED June 3, 1982

PROJECT CPS-Madison PURPOSE Boring

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST Dalton

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
					2 2 5 6		br. to tan f. sand	
5					7 10 13 10		white-gray f. sand w/some br. f. sand and gray clayey silt & lignite gravel at bottom.	
10					10 3 7 13		gray f. to m. sand and lignite.	
15					4 12 17 18		br. to gray f. sand upper ft. gray f. to m. sand lower ft.	
20					16 13 14 [illegible]		gray f. to m. sand w/bottom 3" alternating layers of sand & lignite	
25					24 50 63		tan v.f. sand top gray f. sand w/ lignite and tr gravel	
30					15 20 27 [illegible]		tan v.f. sand w/streaks of gray sand ½" ironstone layer at 31'3" and lignite at bottom	
35					13 19 26 [illegible]		gray v.f. to f sand w/streaks of lignite & f. to m cr. sand ± tr gravel at bottom a 1" lignite layer	

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DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

16+05

ELEVATION
DATE STARTED
DATE FINISHED

PROJECT ____ PURPOSE ____
LOCATION ____ WATER LEVEL ____ DATE ____ TIME ____
TYPE OF DRILLING ____ DRILLER ____ HELPER ____ INSPECTOR OR GEOLOGIST ____

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
0					1 30 66		gray & tan v.f. sand lower 3" - gray f. to m. sand w/lignite	12"sample
5							Top 4" gray m. to c. sand w/streaks of tan clay & lignite Lower 3" gray f. to m. silty sand w/1"gray silty clay	
50					2 9 25 76		Top-gray m. sand Lower-4"laminated gray silty clay	
5					17 38 55 72		alternating layers of black clay w/white to gray vf sand to silt-varved?	
60					7 15 21 30		upper 6" same as last sample - lower 6" gray br. massive clay.	sealed w/2 bags cement 1 bag bentonite
5								
0								
5								

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18+00

BUREAU OF GROUND WATER MANAGEMENT

ELEVATION [illegible]

DATE STARTED [illegible]

PROJECT CPS-Madison PURPOSE Boring DATE FINISHED [illegible]

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING Hollow auger DRILLER Larason HELPER Curran, Ryan INSPECTOR OR GEOLOGIST Dalton

DEPTH	ELEV-ATION	CASING BLOWS/ FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
								No samples taken Sealed w/2 bags of cement and ½ bag bentonite.
5								
10								
15	-72.5'							
20								
25								
30								
35								

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SCREEN SET FROM ______ TO ______ SHEET ______ OF ______

LOG OF GROUND WATER MONITORING ... [illegible] 19+95

PROJECT [illegible] Madison PURPOSE Boring

DATE STARTED May [illegible], 1980

DATE FINISHED May [illegible], 1980

LOCATION ____ WATER LEVEL ____ DATE ____ TIME ____

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST Dalton

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
0–5					[illegible] | [illegible] | 6 | [illegible]		br. to tan v.f. to f. sand	
5–10					7 | 10 | 12 | 13		y.or br. f. sand and gravel w/a clayey lignite layer at top.	
10–15					13 | [illegible] | 17 | [illegible]		or. f. sand w/some gravel	
15–20					13 | 13 | 13 | 13		tan to or. tan f. to c. sand w/1 to 2" layers of f. gravel.	
20–25					32 | 37 | 60 | [illegible]		tan f. to vc. sand tr. lignite	
25–30					6 | 6 | 12 | 17		tan to gray f. to vc. sand w/lower 4" dry clayey v.f. sand tr. of lignite.	
30–35					5 | 7 | 10 | 10		tanish gray vf. sand w/ spots of lignite	
35–40					5 | 9 | [illegible] | [illegible]		tan to gray v.f. sand w/some clay & lignite	

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SCREEN SET FROM ____ TO ____

SHEET 1 OF 2

19+95

WATER LEVEL ______

DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
				[illegible]		Top 3" - Tan vf. sand bottom 6" - redish. vf sand w/ tr. lignite	9" sample
5				7 17 15 19		Top 2" - Tan vf. sand w/some lignite and f. to c. gravel Middle 8" - red vc sand Bottom 2" or. vf. silty sand	
50				7 7 2 3		Vari colored red, y, tan, pink, & or. vf. sand w/layers of lignite & limonite -Note in lower 2" bedding is convolute.	
5				4 17 13 24		Top 10"-pink & y. or. f. to m. sand Bottom 4"-vari colored y., pink, white & gray sandy clay tr. lignite	
60				5 7 26 32		Top 5" vari colored pink, gray, y. & or. clayey sand. Bottom 9" chocholate gray dry clay	
5							No sample taken at 63-67-clay
70				27 34 43 39		Or. to gray f to c. sand w/some gray clay	lost sample and had to regrab. Sealed hole w/ 2 bags cement & ¼ bag bentonite
5							

SHEET 2 OF 2

SCREEN SET FROM ______ TO ______

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SCREEN SET FROM ______ TO ______

SHEET [redacted] OF [redacted]

22+05

DATE STARTED

PROJECT IPS-Madison PURPOSE Boring DATE FINISHED May 20, 1982

LOCATION WATER LEVEL DATE TIME

TYPE OF DRILLING Rotary DRILLER Larason HELPER Ryan INSPECTOR OR GEOLOGIST

DEPTH	ELEVATION	CASING BLOWS/ FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
0–4							gray vf. sand w/ gravel.	No samples taken cd from ditch samples. Not saved
4–10							or. br. f to c. sand w/gravel.	
10–17							or. br. vf. sand w/ gravel	
17–20							or. tan vf. sand tr. gravel ± mica	
20–21							tan vf. sand tr. clay w/heavy lignite layer at 21'	
21–27							Tan vf. sand w/white clay streaks at 25-26 ft	
27–28							lignite layer	
28–40							tan to gray vf. sand w/ heavy lignite layers w/ large mica flakes at 35 ft.	

SCREEN SET FROM TO

SHEET 1 OF 2

SHEET 1 OF 2

22+05

DATE STARTED ______

PROJECT ______ PURPOSE ______ DATE FINISHED ______

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
-0							continued Tan vf. sand w/thin ironstone layers at 42 to 43 ft. tr. to no lignite.	
5								
50								
5								
							gr. tan vf sand w/ lignite	
60							gray vf. sand w/ lignite ironstone, and c. sand	
							gray silty clay	
5								
70							gray vf sand to c. silt	
5								

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SCREEN SET FROM ______ TO ______

SHEET ___ OF ___

22+05

BUREAU OF GROUND WATER MANAGEMENT

ELEVATION ______

DATE STARTED ______

DATE FINISHED ______

PROJECT ______ PURPOSE ______

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
80–97							continued	
97–102.5							tan f. to c. sand w/ lignite	sealed w/ 1½ bag cement pumped to bottom of hole in heavy bentonite slurry.
102.5–118								

A-141

______ SCREEN SET FROM ______ TO ______

SHEET 3 OF 3

BUREAU OF GROUND WATER MANAGEMENT

24+05

ELEVATION ______

DATE STARTED May [illegible]

DATE FINISHED May [illegible]

PROJECT CPS-Madison PURPOSE Boring

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING Chop and wash rotary DRILLER Larason HELPER [illegible] Ryan INSPECTOR OR GEOLOGIST [illegible]

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
0–5					1 / 3 / 4 / 5		Tan to or. br. f. sand w/lignite stringers-some gravel in upper 3"	
5–10					15 / 19 / 14 / 10		Tan to y. or. f. sand w/gray layers tr. lignite & gravel ± mica	
10–15					11 / 17 / 16 / 15		Or. br. f. sand & gravel w/lignite bed & stringers	
15–20					10 / 7 / 8 / 6		Alternating tan to gray f. sand w/or. c. sand & gravel. Lower 3" or. red. f. sand.	
20–25					3 / 4 / [illegible] / 5		Top-tan to or. br. f. sand w/gravel. bottom charcoal gray clay	
25–30					5 / 13 / 15 / 16		Tan to dk. tan f. sand w/gravel stone at bottom	
30–35					11 / 9 / 11 / 15		y. & gray vf. sand + mica	
35–40					7 / 7 / 11 / [illegible]		alternating-or. br, tan, gray, white & bk lignite vf. sand w/2" gray silty clay at the top.	

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SCREEN SET FROM ______ TO ______

SHEET ______ OF ______

BUREAU OF GROUND WATER MANAGEMENT

24+05

ELEVATION ______

DATE STARTED ______

DATE FINISHED ______

PROJECT ______ PURPOSE ______

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
40					5 | 7 | 8 | 9		Or. br. vf. to f. sand w/ 1" gray silty clay at bottom	
5					4 | 7 | 15 | 31		gray to br. gray, tan vf. to f. sand w/2" pink vf sand & streak of clay at bottom	
50					13 | 56 | 50/3"		tan vf. sand	
5								
60					[illegible]		alternating lt. br. to gray br. clay w/gray white clay & vf. sand silty partings in clay	
5					13 | 30 | 52 | 90		alternating gray clay and gray vf. sand w/ 2" to 6" clay & lignite	
70							gray br. lignitic caly	
73								
5								Sealed w/1½ bag of volclay to increase weight the drilling mud.

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______ SCREEN SET FROM ______ TO ______

SHEET 2 OF 2

BUREAU OF GROUND WATER MANAGEMENT

ELEVATION 24+13

DATE STARTED October [illegible]

PROJECT CPS-Madison PURPOSE Boring DATE FINISHED October 15, [illegible]

LOCATION WATER LEVEL DATE TIME

TYPE OF DRILLING Hollow Auger-Rotary DRILLER Larason HELPER Curran, Ryan INSPECTOR OR GEOLOGIST Dalton

DEPTH	ELEV-ATION	CASING BLOWS/ FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
25								
50								
75								
100								
105								
107					13 25 43 60		olive br. massive finely laminated clay	sealed w/3bags cement
0								
5								

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SCREEN SET FROM TO SHEET OF

[illegible]
BUREAU OF GROUND WATER MANAGEMENT

25+97

ELEVATION [illegible]

DATE STARTED June 2?, 198?

PROJECT CPS-Madison PURPOSE Boring DATE FINISHED June 29, 198?

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST Dalton

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SAMPLE SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ____	REMARKS
								Boring no samples sealed hole w/2½ bags cement
25								
50								
75								
87'9"								
0								
5								
0								
5								

A-145

SCREEN CUT FROM ______ TO ______ SHEET 1 OF 1

BUREAU OF GROUND WATER MANAGEMENT

28+55

ELEVATION

DATE STARTED June [illegible], 19[illegible]

PROJECT [illegible]-Madison PURPOSE Boring DATE FINISHED [illegible]

LOCATION WATER LEVEL DATE TIME

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST Dalton

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
10					19 10 16 16		5" mottled gray f. clayey sand, 1" or. sand w/gravel 3" white & or. f. sand 1" tan f. sand 3" white f. sand	13" sample
20					7 19 34 42		2" coarse stone & gravel (foreign) mixed w/tan clay. Tr. of lignite 5" gray f. sand. 1" tan clayey sand 5" gray f. sand	13" sample
30					6 22 43 44		coarse stone at top (foreign) layered ½" or. m. sand 2" gray m. to c. sand w/clay streak. 6½" gray f. sand w½" gray clay in middle 1½" or. f. sand w/ streak 1½" gray f. sand	13" sample

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SCREEN SET FROM TO

SHEET 1 OF 3

28+55

BUREAU OF GROUND WATER MANAGEMENT

ELEVATION ______

DATE STARTED ______

PROJECT ______ PURPOSE ______ DATE FINISHED ______

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEV-ATION	CASING BLOWS/ FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
0					3 | 5 | [illegible] | 14		2" or. f. sand w/gray silty clay at bottom	
5					6 | 11 | 16 | 20		stone at top(foreign) 2"gray clay w. or.f. sand & gravel. 3½" tan to or. vf to f sand w/streak lignite 11" gray f. sand	17"sample
50					3 | 23 | 40 | 45		3½" tan f. sand w/ stones (foreign) 13½" gray v.f. to f. sand	16" sample
5					26 | 48 | 52 | 58		12 " or. m to c. sand 6" or. f. sand	18" sample
							2"or. c. sand mixed w/pink to white clay 12" or. f. to m. sand tr. gravel	14" sample
60					22 | 39 | 50 | 60		3" or. c. sand 5" or. f. sitly sand 1" dk. or. f. sand 6" or. m to c. silty sand 4" or. m. to c. clayey sand 2" white mottled clay	21" sample
5					18 | 35 | 3[illegible] | 60/4"		2" or. c. sand 5" tan f. sand 6" or. f. sand 3" tan f. sand 2" white clay w/or f. sand at bottom	18" sample
70					39 | 53 | 59 | 60/4"		3" tan c. to m. sand 1" white clay 9" tan f. sand 7" tan f. sand	20" sample
5					45 | 79	A-147		lost sample

______ SCREEN SET FROM ______ TO ______

SHEET 2 OF 3

BUREAU OF GROUND WATER MANAGEMENT

ELEVATION 28+55

DATE STARTED ______

PROJECT ______ PURPOSE ______ DATE FINISHED ______

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
80					5 | [illegible] | [illegible] | 50			lost sample
5								
90'					10 | 33 | 42 | 52		7" tan c. sand 5" red br. m. to c. sand w/tr red br. f. clayey sand at bottom	12" sample sealed w/2 3/4 bag cement
5								
0								
5								
0								
5								

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SCREEN SET FROM ______ TO ______

SHEET 3 OF 3

[illegible]
BUREAU OF GROUND WATER MANAGEMENT

30+05

ELEVATION

PROJECT CPS-Madison PURPOSE Boring DATE STARTED July 7, 1980
LOCATION WATER LEVEL DATE FINISHED July 10, 1980
DATE TIME

TYPE OF DRILLING Auger & Rotary DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST Dalton

DEPTH	ELEVATION	CASING BLOWS/ FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
5				SS	4 / 14 / 18 / 22		top=5" gray f. sand 2/Tr f. gravel bottom or. br. f. to c. silty, gravelly sand	18" sample
10				SS	7 / 11 / 12 / 16		layered gray & or. v. f. to f. sand w/several thin tan clay layers	14" sample
15								
20				SS	4 / 5 / 2 / 2		Note-or. v.f. sand in end of tube	lost sample
25								
30				SS	5 / 11 / 15 / 15		gray f. sand w/some dark blotches & tan clay clots	7" sample
35								

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30+05

[illegible]

DATE STARTED ____
DATE FINISHED ____

JECT ____ PURPOSE ____

LOCATION ____ WATER LEVEL ____ DATE ____ TIME ____

TYPE OF DRILLING ____ DRILLER ____ HELPER ____ INSPECTOR OR GEOLOGIST ____

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.				WELL DESIGN	CLASSIFICATION "0" ELEV. = ____	REMARKS
-0										top 2" white clay w/ iron stone bk. f. sand w/lignite & mica Balance a gray f. clay-ey sand	13" sample
5											
50					10	36	24	16			lost sample
5											
60					12	30	40	51		top 2" tan f. to c. sand Balance - layered or. f. sand, white clay, & tan f. sand in 1"-2" layer	9" sample
65					15	43	46	51		top 3" tan c. sand Balance-tan f. sand w/ streak of or. f. sand	13" sample
70					44	51	54	54		tan. f. sand	12" sample
5											

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SCREEN SET FROM ____ TO ____

SHEET 2 OF 3

30+05

DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

ELEVATION ______
DATE STARTED ______
PROJECT ______ PURPOSE ______ DATE FINISHED ______
LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______
TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
80								
5								
90							white clay w/c. sand	lost sample
5							Gray to dk. lignite & clay	
100								
5					9 16 23 29		layered gray & dark gray micaceous silty clay and clay	23" sample
110								bottom of hole at 109 2½ bags of Type II and 1 bag of volclay
5								

DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

32+50

ELEVATION ______

DATE STARTED July 13, [illegible]

DATE FINISHED July 14, [illegible]

PROJECT CPS-Madison PURPOSE Boring

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST Dalton

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
0								
2.5								
5.0								
7.5								
		38 90			63 32 21 30		Top 6" tan f. to med sand w/gravel and pellets or clots of lignite lower 6" br. f. to med silty sand	16" fill 12" sample
0								
5							Sealed w/3 bags Type II & ½ bag of bentonite	
0								
5								

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.EAU OF GROUND WATER MANAGEMENT

ELEVATION 36+10

DATE STARTED July 15, [illegible]

.OJECT CPS-Madison PURPOSE Boring DATE FINISHED [illegible]

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST ______

DEPTH	ELEVATION	CASING BLOWS/ FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
5								
10								
15								
20								
25								
30					13 34 31 23		Top 2" or. f. sand tr ironstone Balance-gray f. sand	11" sample
35					8 19 25 25		5½" gray f. sand 3½ or. f. sand	14" sample

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______ SCREEN SET FROM ______ TO ______

SHEET 1 OF 2

EAU OF GROUND WATER MANAGEMENT

ELEVATION	36 + 10
DATE STARTED	
DATE FINISHED	

OJECT ______ PURPOSE ______

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEV-ATION	CASING BLOWS/ FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION / "0" ELEV. = ______	REMARKS
40					2 | 4 | 5 | 4		5" layered gray f. sand w/½" gray clays 5" gray f. clayey sand	14" sample
45								
50								
55								
60								
65								
70								
					23 | 39 | 35 | 28		1½" gray c. sand mixed w/light gray clay 3½" light gray clay mixed w/stone 1½" y. clay w/iron-stone	6½" sample sealed w/3 bags cement
75								

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SCREEN SET FROM ______ TO ______

SHEET 2 OF 2

DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

37+96

ELEVATION

DATE STARTED Oct. 8, 1981

DATE FINISHED Oct. 9, 1981

PROJECT CPS-Madison PURPOSE Boring

LOCATION WATER LEVEL DATE TIME

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
25								
50								
75								
85					11 19 21 32		gray white sandy clay speckled	24" sample sealed w/3 bags cement ½ bag ben-tonite
0								
5								
0								
5								

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SCREEN SET FROM TO SHEET OF

DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. ~~[illegible]~~
ELEVATION 40+97
DATE STARTED
DATE FINISHED Oct. [illegible]

PROJECT CPS-Madison PURPOSE
LOCATION WATER LEVEL DATE TIME
TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER [illegible] Ryan INSPECTOR OR GEOLOGIST

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
21'6" 23'6" 25					14 19 26 26		4" reddish tan f. to m. sand 1" white clay 10" gray f. sand	15" sample no odor
50								
75 32'6" 34'6"					9 21 32 41		½" tan c. sand balance-gray clay speckled.	13" sample no odor sealed w/2½ bags cement
0								
5								
0								
5								

DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

[illegible] 44 + 96

ELEVATION [illegible]

DATE STARTED Sept. [illegible]

DATE FINISHED Sept. [illegible]

PROJECT CPS-Madison PURPOSE

LOCATION WATER LEVEL DATE TIME

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran, Ryan INSPECTOR OR GEOLOGIST

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
10					12 / 28 / 39 / 50		top-tan f. sand streaked with y. m. to c. sand, gravel; br. f. sand and dk br. f. to m. sand bottom 3½" tanish white m. to c. sand	13" sample no odor
20					3 / 10 / 33 / 26		½" mottled tan clay 1" tan f. sand 1" tan clay 3½" tan f. sand	1[illegible]" sample no odor
30					6 / 19 / 29 / 38		4" mottled tan clay balance-tan f. to m. sand w/streak of y.f. sand & mottled tan clay at top	17" sample no odor

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44+96

BUREAU OF GROUND WATER MANAGEMENT

ELEVATION ______

DATE STARTED ______

PROJECT ______ PURPOSE ______ DATE FINISHED ______

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
[illegible]					[illegible]		mottled tan clay	[illegible]" sample no odor
45								
50								
55								
60								
65								
70'					24 | 43 | 63		gray white clay flaked w/tan clay	15" sample no odor sealed w/2½ bags cement
75								

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SCREEN SET FROM ______ TO ______

SHEET 2 OF 2

DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

47+0B

ELEVATION ______

DATE STARTED Sept. 17, 1981

DATE FINISHED Sept. 23, 1981

PROJECT CPS-Madison PURPOSE Boring

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST ______

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
0–10								
10					5 3 11 13		4" gray clay w/streak y.f. sand Balance-y.f. to m. sand	14" sample no odor
20					6 7 10 40		top-coarse gravel gray f. sand w/streak of y.f. sand	12" sample no odor
30					3 28 37 60			lost sample

A-159

DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

47+07

ELEVATION ______
DATE STARTED ______
DATE FINISHED ______

PROJECT ______ PURPOSE ______

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING ______ DRILLER ______ HELPER ______ INSPECTOR OR GEOLOGIST ______

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
-0					[illegible] | [illegible] | [illegible] | [illegible]		2" tan clay mixed w/ c. sand Balance-tan f. sand	5" sample no odor
5								
50								
5								
60								
5					8 | 23 | 29 | 45		1" gray silty clay 3" gray clay-speckled 3" lt. gray clay 4" y. f. to m. sand 4" lt. gray clay streaked w/y.f.sand 3" dk, gray caly 2" gray m. sand 2" gray clay	23" sample no odor
70					[illegible] | [illegible] | 30 | 30		4" gray clay w/tr.y c. sand at top balance-whitish gray clay	15" sample no odor
5								

A-160

DIV. OF GROUND WATER MANAGEMENT

49+05

ELEVATION ______

DATE STARTED Sept. 15, 1981

DATE FINISHED Sept. 24, 1981

PROJECT CPS-Madison PURPOSE Boring

LOCATION ______ WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING Hollow Auger DRILLER Larason HELPER Curran Ryan INSPECTOR OR GEOLOGIST ______

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
10					21 9 11 12		7½" br. f. sand tr. f. gravel 1" or. f. sand 6" tan f. sand 1" or. f. sand 5" tan f. sand w/ streak gray silt	20½" sample
20					7 7 7 [illegible]		3" br. f. sand w/c. gravel 1½" y. f. sand 2" tan clay 3" gray clay balance-gray f. sand	24" sample chemical odor
30					2 2 4 18		br. gray f. to m. sand w/2" br. gray c. sand & streak of gray clay at bottom	24" sample

A-161

SHEET 1 OF 2

49+05

...SION OF WATER RESOURCES
BAU OF GROUND WATER MANAGEMENT

...JECT	CPS-Madison
PURPOSE	
...OCATION	
WATER LEVEL	
ELEVATION	
DATE STARTED	
DATE FINISHED	
DATE	
TIME	
TYPE OF DRILLING	
DRILLER	Larason
HELPER	Curran, Ryan
INSPECTOR OR GEOLOGIST	

DEPTH	ELEV-ATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "J" ELEV. =	REMARKS
0					9 16 22 22		top-2 pieces of gravel balance-white f. to m. sand w/streaks of gray	17" sample slight chemical odor
					12 16 20 19		2" gray clay balance-gray f. to m. sand w/ streaks lignite	15" sample no odor
					6 15 19 25		14" gray silty clay 1½" lignite 4" gray clay	20" sample
					17 25 26 29		6" gray clay balance-strangers of clay layered w/gray f. sand some silvery gray flakes w/metallic luster.	20" samples
					12 18 24 28			
							top-gray silty clay balance-white clay	17" sample sealed w/2 bags of cement 1 bag bentonite

A-162

J. E. FRITTS & ASSOC. INC.

WCC-1d

: I-5-7-7

Job No. 1-7

Address C.P.S. Gold Bridge N.J.

ed Datum used is

ound Surface this boring is

DEPTH From	To	CLASSIFICATION 1D	Sample & Type No.	Sample Depth		No. of 30" blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in	Lost Water or Remarks
Grd. Surface	2'	Brown + Black Fine Sand						.		
2'	7'	Gray Fine Sand	S-1	4'6"	6'	1	3	8		
7'	19'	Brown Fine To Med								
		Wet Sand + Gravel	S-2	7'6"	9'	5	8	12		
		Incounter Water At 10'	S-3	14'6"	16'	8	2	12		
19'	29'	Brown Fine Sand	S-4	19'6"	21'	5	8	10		
			S-5	24'6"	26'	4	7	9		
29'	34'	Brown Very Fine	S-6	29'6"	31'	W.O.R				
		Sand, Traces of Clay								
34'	39'	Brown + Gray Fine Sand	S-7	34'6"	36'	10	39	20		
39'	44'	Brown Gray Fine Sand	S-8	39'6"	41'	4	6	19		
		Traces of Small Gravel								
44'	49'	Light Brown Fine Sand	S-9	44'6"	45'6"	22	50			
49'	64'	Brown With Layers	S-10	49'6"	51'	4	6	9		
		of Fine Sand	S-11	54'6"	55'10"	18	45	50/4		
64'	70'	Br. + Some Black Gray	12	59.6'	61'	11	16	18		
		F/sand + F/clay lenses	13	64.6	66	7	14	17		
70	80	Gray F/ sand	F. 14	69.6	70.6	33	59		0	
80	84	Br. F/ sand + F/gravel	wash 15	75'	—					
84'	90'	Orange + Lt. Br. + silty F/	16	80'	—					
		sand	17	85'	86.5	7	36	50/5		
90'	95	Gray F/C sand + F/gravel	18	90'	—	wash	Sample			
		+ clay	18A	90'	91.6	8	10	24		
95	100'	Gray F/m sand some Black	19'	95'	—	wash	Sample			
		Streaks								
100	101.6	Gray Stiff Clay Almost	20	100'	101.6	20	37	60/4"		
		Dry w/ F/ sand seams								

Ground Surface to _____ ft. used _____ casing.

Foreman [signature]

Water level is _____ ft. below Ground surface at completion

Water level is _____ ft. Below Ground surface _____ A-163 ompletion.

Boring stopped by _____

Boring No. B1A

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

PERMIT NO. ____

APPLICATION NO. ____

COUNTY Middlesex

WELL RECORD

OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

Owner's Well No. WCC-1d SURFACE ELEVATION ____ Feet (Above mean sea level)

LOCATION ____

DATE COMPLETED 6 Jan 81 DRILLER J.E. Fritts, Co.

DIAMETER: Top 6 inches Bottom 6 inches TOTAL DEPTH 101 Feet

CASING: Type Sch 40 PVC Diameter 2 Inches Length 91 Feet

SCREEN: Type Sch 40 PVC Size of Opening 0.020 Diameter 2 Inches Length 10 Feet

Range in Depth { Top 91 Feet / Bottom 101 Feet } Geologic Formation - Raritan

Tail Piece: Diameter ____ Inches Length ____ Feet

WELL FLOWS NATURALLY ____ Gallons per minute at ____ Feet above surface

Water rises to ____ Feet above surface

RECORD OF TEST: Date ____ Yield ____ Gallons per minute

Static water level before pumping ____ Feet below surface

Pumping level ____ feet below surface after ____ hours pumping

Drawdown ____ Feet Specific Capacity ____ Gals. per min. per ft. of drawdown

How pumped ____ How measured ____

Observed effect on nearby wells ____

PERMANENT PUMPING EQUIPMENT:

Type ____ Mfrs. Name ____

Capacity ____ G.P.M. How Driven ____ H.P. ____ R.P.M. ____

Depth of Pump in well ____ Feet Depth of Footpiece in well ____ Feet

Depth of Air Line in well ____ Feet Type of Meter on Pump ____ Size ____ Inches

USED FOR monitoring AMOUNT { Average ____ Gallons Daily / Maximum ____ Gallons Daily }

QUALITY OF WATER ____ Sample: Yes ____ No ____

Taste ____ Odor ____ Color ____ Temp. ____ °F.

LOG descriptive Are samples available? yes

(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

SOURCE OF DATA Woodward-Clyde Consultants

DATA OBTAINED BY Woodward-Clyde Consultants Date 6 Jan 81

(NOTE: Use other side of this sheet for additional information such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)

W-2m

1-20-80

J. E. FRITTS & ASSOC. INC.

Job No.

Address Old Bridge, N.J.

Fixed Datum used is

Ground Surface this boring is

Depth From	Depth To	CLASSIFICATION 2M	Sample & Type No.	Sample Depth		No. of 30" blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in.	Last Water or Remarks
Grd. Surface	20'	Brown Fine To med	S-1	5'	6'6"	10	25	19		WAS BUTT
		Sand + Gravel	S-2	10'	11'6"	3	6	4		
		~~[illegible]~~	S-3	15'	16'6"	7	12	19		
		Encounter water at 5'	S-4	20'	21'6"	4	6	6		5 m
20'	30'	Gray Fine sand	S-5	25'	26'6"	7	7	8		
		with Layers of Brown								
30'	40'	Black To Gray Silty	S-6	30'	31'6"	4	5	6		
		Fine sand	S-7	35'	36'6"	4	6	12		
40'	55'	Brown Fine To med sand	S-8	40'	41'6"	6	21	40		5 m
			S-9	45'	46'6"	16	36	34		
			S-10	50'	51'6"	9	9	26		5 m
55'	55'	Brown gray silty Fine	S-11	55'	55'	80/2"	50/3"			5 m
		sand with med sand.								

Installed 55' 2" P.V.C. Screen 45 - 55'
w/ Sand Pack to 42' to 55' & mud seal
42' up to top of Hole

Ground Surface to ______ ft. used ______ casing.

Water level is ______ ft. below Ground surface at completion.

Water level is ______ ft. below Ground surface ______ hr after completion.

A-165

Boring stopped by

Foreman E. Hyder

Boring No. B-2

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

PERMIT NO.
APPLICATION NO.
COUNTY Middlesex

WELL RECORD

OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

Owner's Well No. WCC- 2M SURFACE ELEVATION ______ Feet (Above mean sea level)

LOCATION

DATE COMPLETED 20 Jan 81 DRILLER J.E. Fritts, Co.

DIAMETER: Top 6 inches Bottom 6 inches TOTAL DEPTH 56 Feet

CASING: Type Sch 40 PVC Diameter 2 Inches Length 46 Feet

SCREEN: Type Sch 40 PVC Size of Opening 0.020 Diameter 2 Inches Length 10 Feet

Range in Depth { Top 46 Feet, Bottom 56 Feet } Geologic Formation Raritan

Tail Piece: Diameter ______ Inches Length ______ Feet

WELL FLOWS NATURALLY ______ Gallons per minute at ______ Feet above surface

Water rises to ______ Feet above surface

RECORD OF TEST: Date ______ Yield ______ Gallons per minute

Static water level before pumping ______ Feet below surface

Pumping level ______ feet below surface after ______ hours pumping

Drawdown ______ Feet Specific Capacity ______ Gals. per min. per ft. of drawdown

How pumped ______ How measured ______

Observed effect on nearby wells ______

PERMANENT PUMPING EQUIPMENT:

Type ______ Mfrs. Name ______

Capacity ______ G.P.M. How Driven ______ H.P. ______ R.P.M. ______

Depth of Pump in well ______ Feet Depth of Footpiece in well ______ Feet

Depth of Air Line in well ______ Feet Type of Meter on Pump ______ Size ______ Inches

USED FOR monitoring AMOUNT { Average ______ Gallons Daily, Maximum ______ Gallons Daily }

QUALITY OF WATER ______ Sample: Yes ______ No ______

Taste ______ Odor ______ Color ______ Temp. ______ °F.

LOG descriptive Are samples available? yes
(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

SOURCE OF DATA Woodward-Clyde Consultants

DATA OBTAINED BY Woodward-Clyde Consultants Date 20 Jan 81

(NOTE: Use other side of this sheet for additi[onal infor]mation such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)

WCC-3d

J. E. FRITTS & ASSOC. INC.

Date 1-5-21

Job Address Old Bridge, N.J.

Job No.

Fixed Datum used is

Ground Surface this boring is

Depth From	Depth To	CLASSIFICATION 3D	Sample & Type No.	Sample Depth		No. of 30" blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in.	Lost Water or Remarks
Grd. Surface	2'	Brown Sand, Gravel								
		+ small Black Topsoil								
2'	5'	Dark Brown Fine Sand	S-1	2'	3'6"	5	9	13		
5'	10'	Brown + Gray Fine	S-2	5'	6'6"	7	11	18		
		Sand, Traces of Silt	S-3	8'	9'6"	5	8	9		
		Incounter water 8'6"								
10'	15'	Gray Fine To med	S-4	10'6"	12'	3	4	12		
		Sand, Traces of Gravel								
15'	29'6"	Gray Fine To med Sand	S-5	15'	16'6"	14	34	25		
			S-6	20'	21'6"	7	11	22		
			S-7	25'	26'6"	8	20	33		
29'6"	34'	Gray Fine To med Sand	S-8	30'	31'6"	6	37	50/3"		
		Traces of Silt	S-9	35'	35'3"	13	36	50/3"		
40'	44'10"	Gray Fine To med	S-10	40'	41'3"	8	33	50/3"		
		Sand	S-11	45'	46'3"	16	43	50/3"		
44'10"	56'	Gray Silty Clay	S-12	50'	51'6"	16	32	31		2 Sample
			S-13A	55'	56'6"	7	13	27		
56'	60'	Gray Black Sandy Silt	S-13B	55'	56'6"	7	13	27		
		with small Traces of mica								
60'	70'	Gray Silty Clay	S-14	60'	61'6"	8	15	25		2 Sample
			S-15	65'	66'6"	6	9	14		
70'	75'	Gray + Brown Fine	S-16	70'	71'6"	5	6	6		
		To med Sand								
75'	80'	Brown Fine To med Sand	S-17	75'	76'3"	10	20	50/3"		
		Traces of Sandy Clay								
80'	81'4"	Brown Fine Sand	S-18	80'		36	100/3	?		
		Installed 10' screen + 74' 2" PVC pipe Total 84'								

3' Stick up From ground

Ground Surface to ____ ft. used ____ casing.

Water level ____ ft. below Ground surface at completion. A-167

Water level ____ ft. below Ground surface ____ hrs. after completion.

Boring stopped by ____

Foreman Miller + Thompson

Boring No. B-3A

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

PERMIT NO. 28-10058 [illegible]

APPLICATION NO.

COUNTY Middlesex

WELL RECORD

1. OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

Owner's Well No. WCC-3D SURFACE ELEVATION ______ Feet (Above mean sea level)

2. LOCATION

3. DATE COMPLETED 6 Jan 81 DRILLER J.E. Fritts, Co.

4. DIAMETER: Top 6 inches Bottom 6 inches TOTAL DEPTH 81 Feet

5. CASING: Type Sch 40 PVC Diameter 2 Inches Length 84 Feet

6. SCREEN: Type Sch 40 PVC Size of Opening 0.020 Diameter 2 Inches Length 10 Feet

Range in Depth: Top 71 Feet, Bottom 81 Feet Geologic Formation Raritan

Tail Piece: Diameter ______ Inches Length ______ Feet

7. WELL FLOWS NATURALLY ______ Gallons per minute at ______ Feet above surface

Water rises to ______ Feet above surface

8. RECORD OF TEST: Date ______ Yield ______ Gallons per minute

Static water level before pumping ______ Feet below surface

Pumping level ______ feet below surface after ______ hours pumping

Drawdown ______ Feet Specific Capacity ______ Gals. per min. per ft. of drawdown

How pumped ______ How measured ______

Observed effect on nearby wells ______

9. PERMANENT PUMPING EQUIPMENT:

Type ______ Mfrs. Name ______

Capacity ______ G.P.M. How Driven ______ H.P. ______ R.P.M. ______

Depth of Pump in well ______ Feet Depth of Footpiece in well ______ Feet

Depth of Air Line in well ______ Feet Type of Meter on Pump ______ Size ______ Inches

10. USED FOR monitoring AMOUNT: Average ______ Gallons Daily, Maximum ______ Gallons Daily

11. QUALITY OF WATER ______ Sample: Yes ______ No ______

Taste ______ Odor ______ Color ______ Temp. ______ °F.

12. LOG descriptive Are samples available? yes

(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

13. SOURCE OF DATA Woodward-Clyde Consultants

14. DATA OBTAINED BY Woodward-Clyde Consultants Date 6 Jan 81

(NOTE: Use other side of this sheet for additional information such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)

J. E. FRITTS & ASSOC. INC.

1-14-81

Job No. 290041C7

Job Address Old Bridge, N.J. 5" ID Augers

Fixed Datum used is

Ground Surface this boring is

DEPTH From	DEPTH To	CLASSIFICATION B-4A 4M	Sample & Type No.	Sample Depth		No. of 30" blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in.	Last Water or Remarks
Grd. Surface	1.5'	Cement Soil	SS							
1.5	3½	Black Cinders, Gravel								
3½	8'	Br. clayey F/C Sand & Gravel	1	4½'	6'	8	12	16		
8	13'	Br. Yellow Gr. F/wet Sand	2	9½'	11'	5	5	7		
13	18'	Br. F/Yellow Br. F/Sandy	3	14½'	16'	9	16	24		
		Clay								
		Gray F/wet Sand	4	19½'	21'	8	19	44		
		F/Yellow at 24'-26'	5	24½'	26'	10	10	15		
			6	29½'	30.9'	10	42	50/3"		
	47½'		7	34½'	35.9'	8	41	50/4"		
		Black & Gray Clay Mat.	8	39½'	41½'	2	3	10		
		F/F Sand Lenses Organic	9	44½'	46'	11	47	55		
		Odor Drilled Stiff								
	73	Gray F/Sand wet	10	49½'	51'	15	29	29		
		"	11	54½'	56'	5	14	36		
	80.2	Lt. Br. F/wet Sand F/F	12	59½'	61'	32	48	62		
		Orange Specs.	13	64½'	66'	14	41	50/2"		
			14	69½'	70'	10	22	50/1"		
		F/Yellow Clay at 79	15	74½'	75'	83/6"				

Ground Surface to ______ ft. used ______ casing.

Water level is ______ ft. below Ground surface at completion. A-169

Water level is ______ ft. below Ground surface ______ hrs. after completion.

Boring stopped by ______

Foreman [signature]

Boring No. B-4A

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

WELL RECORD

PERMIT NO.
APPLICATION NO.
COUNTY Middlesex

OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

Owner's Well No. WCC- 4M SURFACE ELEVATION ______ Feet (Above mean sea level)

LOCATION

DATE COMPLETED 14 Jan 81 DRILLER J.E. Fritts, Co.

DIAMETER: Top 6 inches Bottom 6 inches TOTAL DEPTH ______ Feet

CASING: Type Sch 40 PVC Diameter 2 Inches Length 47 Feet

SCREEN: Type Sch 40 PVC Size of Opening 0.020 Diameter 2 Inches Length 10 Feet

Range in Depth { Top 47 Feet, Bottom 57 Feet } Geologic Formation Raritan

Tail Piece: Diameter ______ Inches Length ______ Feet

WELL FLOWS NATURALLY ______ Gallons per minute at ______ Feet above surface

Water rises to ______ Feet above surface

RECORD OF TEST: Date ______ Yield ______ Gallons per minute

Static water level before pumping ______ Feet below surface

Pumping level ______ feet below surface after ______ hours pumping

Drawdown ______ Feet Specific Capacity ______ Gals. per min. per ft. of drawdown

How pumped ______ How measured ______

Observed effect on nearby wells ______

PERMANENT PUMPING EQUIPMENT:

Type ______ Mfrs. Name ______

Capacity ______ G.P.M. How Driven ______ H.P. ______ R.P.M. ______

Depth of Pump in well ______ Feet Depth of Footpiece in well ______ Feet

Depth of Air Line in well ______ Feet Type of Meter on Pump ______ Size ______ Inches

USED FOR monitoring AMOUNT { Average ______ Gallons Daily, Maximum ______ Gallons Daily }

QUALITY OF WATER ______ Sample: Yes ______ No ______

Taste ______ Odor ______ Color ______ Temp. ______ °F.

LOG descriptive Are samples available? yes

(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

SOURCE OF DATA Woodward-Clyde Consultants

DATA OBTAINED BY Woodward-Clyde Consultants Date 14 Jan 81

(NOTE: Use other side of this sheet for additional information such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)

W11-5M

J. E. FRITTS & ASSOC. INC.

-15-81

Job No. 29C34 103

Address Old Bridge N.J.

...xed Datum used is

...round Surface this boring is

Depth From	Depth To	Classification B-5M	Sample & Type No.	Sample Depth		No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in	Last Water or Remarks
Grd. Surface	7½'	FILL CINDERS & BR.								
		SAND & GRAVEL	SS1	4½'	6'	6	13	21		
7½'		TAN & BR. F/WET SAND	2	9.6'	11'	4	7	10		9'
		SOIL STARTS AT 19'	3	14.6'	16'	11	7	7		
		SULPHUR ODOR. TO	4	19.6'	21'	5	7	14		
		DARK GRAY F/M SAND AS?								
22'	28'	DARK GRAY TO BR. F/M								
		SAND WET W/ SOME	5	24'	25.6'	16	32	50/3"		
		GRAVEL W/ SAME ODOR								
28'	33'	LT. GRAY TO TAN F/M	6	29.6'	30'	95/6"				
		SAND WET NO ODOR								
33'	35.9'	GRAY TO TAN F/M C.	7	34.6'	35.0'	18	53	50/5"		
		WET SAND LITTLE CLAY								
		34.6' IN SPOON								

INSTALLED 2" P.V.C. TO 35' W/ SCREEN 25'-3[illegible]
SAND PACK 35' UP TO 22.0' THEN [illegible]
AND 22' TO TOP OF HOLE

Ground Surface to ______ ft. used ______ casing.

Water level is ______ ft. below Ground surface at completion.

Water level is ______ ft. below Ground surface ______ hrs A-171 pletion.

Boring stopped by ______

Foreman [signature]

Boring No. B-5

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

PERMIT NO. 28-12058

APPLICATION NO. ______

COUNTY Middlesex

WELL RECORD

1. OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

Owner's Well No. WCC-5M SURFACE ELEVATION ______ Feet (Above mean sea level)

2. LOCATION ______

3. DATE COMPLETED 15 Jan 81 DRILLER J.E. Fritts, Co.

4. DIAMETER: Top 6 inches Bottom 6 inches TOTAL DEPTH 36 Feet

5. CASING: Type Sch 40 PVC Diameter 2 Inches Length 25 Feet

6. SCREEN: Type Sch 40 PVC Size of Opening 0.020 Diameter 2 Inches Length 10 Feet

Range in Depth { Top 25 Feet; Bottom 35 Feet }

Geologic Formation Raritan

Tail Piece: Diameter ______ Inches Length ______ Feet

7. WELL FLOWS NATURALLY ______ Gallons per minute at ______ Feet above surface

Water rises to ______ Feet above surface

8. RECORD OF TEST: Date ______ Yield ______ Gallons per minute

Static water level before pumping ______ Feet below surface

Pumping level ______ feet below surface after ______ hours pumping

Drawdown ______ Feet Specific Capacity ______ Gals. per min. per ft. of drawdown

How pumped ______ How measured ______

Observed effect on nearby wells ______

9. PERMANENT PUMPING EQUIPMENT:

Type ______ Mfrs. Name ______

Capacity ______ G.P.M. How Driven ______ H.P. ______ R.P.M. ______

Depth of Pump in well ______ Feet Depth of Footpiece in well ______ Feet

Depth of Air Line in well ______ Feet Type of Meter on Pump ______ Size ______ Inches

10. USED FOR monitoring AMOUNT { Average ______ Gallons Daily; Maximum ______ Gallons Daily }

11. QUALITY OF WATER ______ Sample: Yes ______ No ______

Taste ______ Odor ______ Color ______ Temp. ______ °F.

12. LOG descriptive Are samples available? yes

(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

13. SOURCE OF DATA Woodward-Clyde Consultants

14. DATA OBTAINED BY Woodward-Clyde Consultants Date 15 Jan 81

(NOTE: Use other side of this sheet for additional information such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)

[illegible]

J. E. FRITTS & ASSOC. INC.

...e 1-12-81

Job No. 79C08/[illegible]

... Address Old Bridge, N.J.

...ed Datum used is

...ound Surface this boring is 5" I.D. Auger

DEPTH From	DEPTH To	CLASSIFICATION 6-D	Sample & Type No.	Sample Depth	No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in.	Last Water or Remarks
Grd. Surface	4'6"	Brown Fine To Coarse	S-1	4'6" 6'	9	7	4		
		Sand with Pebbles	S-2	9'6" 11'	16	11	14		
..'6"	34'	Gray med Sand	S-3	14'6" 16'	3	3	8		
			S-4	19'6" 21'	7	10	34		
			S-5	24'6" 26'	8	16	24		Wash ... time
			S-6	29'6" 31'	7	9	13		10 min
..4'	39'	Gray Fine med Sand	S-7	34'6" 36'	11	12	15		15
		Traces of Silty Clay							
..'	57'	Grayish white Fine Sand	S-8	39'6" 40'6"	18	50/6"			
			S-9	44'6" 46'	7	11	11		10
			S-10	49'6" 51'	16	24	37		
			S-11	54'6" 56'	8	20	34		
..'	74'	Light Brown Fine Sand	S-12	59'6" 61'	13	15	24		10
			S-13	64'6" 66'	10	8	10		
			S-14	69'6" 71'	13	9	9		
..'	78.6	Brown + Gray Fine Sand	S-15	74'6" 75'6"	38	100/6"			15
		With Layers of Silty Clay	16	79.6" 80.6'	14	100/6"			
78.6	80.6'	Br. & Gray F/ Sand +							

...round Surface to ______ ft. used ______ casing.

A-173

...ater level is ______ ft. below Ground surface at completion.

...ater level is ______ ft. below Ground surface ______ hrs. after completion

Foreman E. Higgins

B/A

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

PERMIT NO. ______
APPLICATION NO. ______
COUNTY Middlesex

WELL RECORD

OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

Owner's Well No. WCC-6D SURFACE ELEVATION ______

LOCATION ______

DATE COMPLETED 12 Jan 81 DRILLER J.E. Fritts, Co.

DIAMETER: Top 6 inches Bottom 6 inches TOTAL DEPTH 80 Feet

CASING: Type Sch 40 PVC Diameter 2 Inches Length 65 Feet

SCREEN: Type Sch 40 PVC Size of Opening 0.020 Diameter 2 Inches Length 10 Feet

Range in Depth Top 65 Feet Bottom 75 Feet Geologic Formation ______

Tail Piece: Diameter 2 Inches Length 5 Feet

WELL FLOWS NATURALLY ______ Gallons per minute at ______ Feet above surface

Water rises to ______ Feet above surface

RECORD OF TEST: Date ______ Yield ______ Gallons per minute

Static water level before pumping ______ Feet below surface

Pumping level ______ feet below surface after ______ hours pumping

Drawdown ______ Feet Specific Capacity ______ Gals. per min. per ft. of drawdown

How pumped ______ How measured ______

Observed effect on nearby wells ______

PERMANENT PUMPING EQUIPMENT:

Type ______ Mfrs. Name ______

Capacity ______ G.P.M. How Driven ______ H.P. ______ R.P.M. ______

Depth of Pump in well ______ Feet Depth of Footpiece in well ______ Feet

Depth of Air Line in well ______ Feet Type of Meter on Pump ______ Size ______ inches

USED FOR monitoring AMOUNT Average ______ Gallons Daily Maximum ______ Gallons Daily

QUALITY OF WATER ______ Sample: Yes ______ No ______

Taste ______ Odor ______ Color ______ Temp. ______ oF

LOG descriptive Are samples available? yes

(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

SOURCE OF DATA Woodward-Clyde Consultants

DATA OBTAINED BY Woodward-Clyde Consultants Date 12 Jan 81

(NOTE: Use other side of this sheet for additional information such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangement, etc.)

WCC-7m

1-16-81

J. E. FRITTS & ASSOC. INC.

Job No. 79C04103

Job Address Old Bridge, N.J. · C.P.S. Chemicals Co.

Fixed Datum used is

Ground Surface this boring is

DEPTH From	DEPTH To	CLASSIFICATION B-7 7M	Sample & Type No.	Sample Depth		No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in	Lost Water or Remarks
Grd. Surface	7									
		Br. Fill Sand & Pebbles	SS1	4.6	6	8	17	16		
7'	17'	Br. F/m sand & gravel	2	9.6	11	17	21	22		
		Lost at 8.6 ±	3	14.6	16	7	4	7		
17'	23'	Br. silt & lt. gray	4	19.6	21	13	23	69		
		Silty sand	5	24.6	26	22	40	35		
23'	28'	Pebble & gray f/sand	6	29.6	31	9	10	9		
28'	33'	Br. F/m sand wet								
		& clay	7	34.6	36	18	16	17		
33'	38'	& sand gray								
38'	42'	f/c gray wet sand	8	39.6	41	8	3	7		
42'	52'	Lt. gray silty sand	9	44.6	46	8	3	5		
		Yellow Br. F/m silty	10	49.6	51	19	15	14		
		sand wet	11	54.6	55.8	69	52/1"			
52'	55.8'	& white sand								

Installed P.V.C. to 55' w/ 10' screen 55' to 45' & sand pack 55' to 40' then trick mud seal to surface

Ground Surface to ______ ft. used ______ casing.

Water level is ______ ft. below Ground surface at completion A-175

Water level is ______ ft. below Ground surface ______ hrs. after completion.

Foreman [signature]

Boring No. B-7

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

PERMIT NO. 28-12055

APPLICATION NO.

COUNTY Middlesex

WELL RECORD

OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

Owner's Well No. WCC-7M SURFACE ELEVATION ______ Feet (Above mean sea level)

LOCATION

DATE COMPLETED 16 Jan 81 DRILLER J.E. Fritts, Co.

DIAMETER: Top 6 inches Bottom 6 inches TOTAL DEPTH 55 Feet

CASING: Type Sch 40 PVC Diameter 2 Inches Length 45 Feet

SCREEN: Type Sch 40 PVC Size of Opening 0.020 Diameter 2 Inches Length 10 Feet

Range in Depth { Top 45 Feet, Bottom 55 Feet } Geologic Formation Raritan

Tail Piece: Diameter ______ Inches Length ______ Feet

WELL FLOWS NATURALLY ______ Gallons per minute at ______ Feet above surface

Water rises to ______ Feet above surface

RECORD OF TEST: Date ______ Yield ______ Gallons per minute

Static water level before pumping ______ Feet below surface

Pumping level ______ feet below surface after ______ hours pumping

Drawdown ______ Feet Specific Capacity ______ Gals. per min. per ft. of drawdown

How pumped ______ How measured ______

Observed effect on nearby wells ______

PERMANENT PUMPING EQUIPMENT:

Type ______ Mfrs. Name ______

Capacity ______ G.P.M. How Driven ______ H.P. ______ R.P.M. ______

Depth of Pump in well ______ Feet Depth of Footpiece in well ______ Feet

Depth of Air Line in well ______ Feet Type of Meter on Pump ______ Size ______ Inches

USED FOR monitoring AMOUNT { Average ______ Gallons Daily, Maximum ______ Gallons Daily }

QUALITY OF WATER ______ Sample: Yes ______ No ______

Taste ______ Odor ______ Color ______ Temp. ______ °F.

LOG descriptive Are samples available? yes

(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

SOURCE OF DATA Woodward-Clyde Consultants

DATA OBTAINED BY Woodward-Clyde Consultants Date 16 Jan 81

(NOTE: Use other side of this sheet for addi... ...nation such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)

WCC-9m

J. E. FRITTS & ASSOC. INC.

Date 4-15-81 Job No. 79C044C

Job Address Old Bridge N.J.

Fixed Datum used is

Ground Surface this boring is

DEPTH From	DEPTH To	CLASSIFICATION 9-M	Sample & Type No.	Sample Depth		No of 30" blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery	
Grd. Surface	1'	TOP SOIL	SS							
1'	25	STRAIGHT AUGER TO 25'								
25	29	LT. BR. - GRAY F/M WET SAND	1	25'	26.6	7	10	19		
29'	33	BR. F/M WET SAND W/ SOME BLACK LAYERS	2	30'	31.6	10	27	36		
33	40'	WET F/M BR. SAND	3	35'	36.6	16	39	46		
40'	42'	BR. BR. F/M SAND & TAN SILT LAYER	4	40'	41.6	9	18	25		
			5	45'	46.6	15	21	37		
42'	53	BR. F/M WET SAND	6	50'	51.6	10	35	62		
53'	56.6	GRAY F/M WET SAND	7	55'	56.6	26	35	53		
		END BORING 56.6'								

INSTALLED 56' 2" PVC. INCLUDING SCREEN 1[illegible]
SAND PACK 55' UP TO 42'
HEAVY MUD SEAL 42' UP TO 2'
INSTALLED STEEL CASING PROTECTOR [illegible]
+1' W/ CONCRETE SEAL 2' UP TO GROUND
SURFACE (LOCKABLE)

USED 36 BAGS SAND MIX
16 BAG MUD
16 BAG CONCRETE

Ground Surface to ______ ft. used ______ casing.

Water level is ______ ft. below Ground surface at completion.

Water level is ______ ft. below Ground surface ______ after completion.

Boring stopped by ______

Foreman [signature]

Boring No. 9

Form DWR-138
1/80

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

FOR MONITORING PURPOSES ONLY

WELL RECORD

23-12236
PERMIT NO. ______

APPLICATION NO. ______

COUNTY Middlesex

1. OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

   Owner's Well No. WCC- 9m SURFACE ELEVATION ______ Feet (Above mean sea level)

2. LOCATION ______

3. DATE COMPLETED 15 Apr 81 DRILLER J.E. Fritts, Co.

4. DIAMETER: Top 10 inches Bottom 10 inches TOTAL DEPTH 55.5 Feet

5. CASING: Type Sch 40 PVC Diameter 2 Inches Length 45 Feet

6. SCREEN: Type Sch 40 PVC Size of Opening 0.020" Diameter 2 Inches Length 10 Feet

   Range in Depth { Top 45 Feet; Bottom 55 Feet } Geologic Formation Raritan

   Tail Piece: Diameter ______ Inches Length ______ Feet

7. WELL FLOWS NATURALLY ______ Gallons per minute at ______ Feet above surface

   Water rises to ______ Feet above surface

8. RECORD OF TEST: Date ______ Yield ______ Gallons per minute

   Static water level before pumping ______ Feet below surface

   Pumping level ______ feet below surface after ______ hours pumping

   Drawdown ______ Feet Specific Capacity ______ Gals. per min. per ft. of drawdown

   How pumped ______ How measured ______

   Observed effect on nearby wells ______

9. PERMANENT PUMPING EQUIPMENT:

   Type ______ Mfrs. Name ______

   Capacity ______ G.P.M. How Driven ______ H.P. ______ R.P.M. ______

   Depth of Pump in well ______ Feet Depth of Footpiece in well ______ Feet

   Depth of Air Line in well ______ Feet Type of Meter on Pump ______ Size ______ Inches

10. USED FOR monitoring AMOUNT { Average ______ Gallons Daily; Maximum ______ Gallons Daily }

11. QUALITY OF WATER ______ Sample: Yes ______ No ______

    Taste ______ Odor ______ Color ______ Temp. ______ °F.

12. LOG descriptive Are samples available? yes

    (Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

13. SOURCE OF DATA Woodward-Clyde Consultants

14. DATA OBTAINED BY Woodward-Clyde Consultants Date 15 Apr 81

(NOTE: Use other side of this sheet for add A-178 *rmation such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)*

WCC-11d

* USED 5½ BAGS SAND
1½ BAG
2 BAGS CEMENT

J. E. FRITTS & ASSOC. INC.

Job No. 29C04103E

Date 4-16-81

Job Address Old Bridge N.J.

Fixed Datum used is

Ground Surface this boring is

DEPTH From	DEPTH To	CLASSIFICATION 11-D	Sample & Type No.	Sample Depth		No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in.	Lost Water or Remarks
			SS							
Grd. Surface	1.6	TOP SOIL								
1.6	25	STRAIGHT AUGER	1	25	26.6	10	25	32		
25	29	BR. & GRAY F/M WET SAND	2	30	31.6	1	2	6		
29	33	GRAY SILTY F/M SAND	3	35	36.6	17	25	28		
33	39	GRAY, BR. WET F/M SAND F. SILTY	4	40	41.6	7	11	24		
39	43	GRAY SILTY F/M WET SAND	5	45	46.6	12	29	48		
43	48	TAN TO BR. F/M SILTY WET SAND	6	50	51.4	18	60	50/4		
48	54	M/GRAY/F WET SAND SOME SILT	7	55	56.6	10	24	39		
54	64	GRAY M/TO F/ SAND WET	8	60	61.4	13	62	50/4	0	
64	67	ORANGE & BR. F/M WET CLAYEY SAND	8	65	66.6	28	31	50		
67	71.6	GRAY STIFF CLAY DRY	9	70	71.6	17	26	29		

– END of BORING –

INSTALLED 68'-2" P.V.C. & SCREEN TOTAL LENGTH
SAND PACK 70' TO 52' W/ BOTTOM of SCREEN
AT 68'
MUD PACK 52' UP TO 2' HIGH MUD
CEMENT PACK W/ STEEL CASING 2' UP TO
0' W/ 1' STICK UP of CASING

Ground Surface to ______ ft. used ______ casing.

Foreman [signature]

Water level is ______ ft. below Ground surface at completion.

______ after completion.

Water level is ______ ft. below Ground surface ______

Boring No. 11D

Boring stopped by ______

Form DWR-133
11 80

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

WELL RECORD

28-12212 to
28-12236
PERMIT NO. ______
APPLICATION NO. ______
COUNTY Middlesex

1. OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ
   Owner's Well No. WCC- 11d SURFACE ELEVATION ______ Feet (Above mean sea level)
2. LOCATION ______
3. DATE COMPLETED 16 Apr 81 DRILLER J.E. Fritts, Co.
4. DIAMETER: Top 10 inches Bottom 10 inches TOTAL DEPTH 71.5 Feet
5. CASING: Type Sch 40 PVC Diameter 2 Inches Length 55 Feet
6. SCREEN: Type Sch 40 PVC Size of Opening 0.020" Diameter 2 Inches Length 10 Feet
   Range in Depth { Top 55 Feet; Bottom 65 Feet } Geologic Formation Raritan
   Tail Piece: Diameter 2 Inches Length 5 Feet
7. WELL FLOWS NATURALLY ______ Gallons per minute at ______ Feet above surface
   Water rises to ______ Feet above surface
8. RECORD OF TEST: Date ______ Yield ______ Gallons per minute
   Static water level before pumping ______ Feet below surface
   Pumping level ______ feet below surface after ______ hours pumping
   Drawdown ______ Feet Specific Capacity ______ Gals. per min. per ft. of drawdown
   How pumped ______ How measured ______
   Observed effect on nearby wells ______
9. PERMANENT PUMPING EQUIPMENT:
   Type ______ Mfrs. Name ______
   Capacity ______ G.P.M. How Driven ______ H.P. ______ R.P.M. ______
   Depth of Pump in well ______ Feet Depth of Footpiece in well ______ Feet
   Depth of Air Line in well ______ Feet Type of Meter on Pump ______ Size ______ Inches
10. USED FOR monitoring AMOUNT { Average ______ Gallons Daily; Maximum ______ Gallons Daily }
11. QUALITY OF WATER ______ Sample: Yes ______ No ______
    Taste ______ Odor ______ Color ______ Temp. ______ °F.
12. LOG descriptive Are samples available? yes
    (Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)
13. SOURCE OF DATA Woodward-Clyde Consultants
14. DATA OBTAINED BY Woodward-Clyde Consultants Date 16 Apr 81

A-180

(NOTE: Use other side of this sheet for additiona[l information] on such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)

WCC-12m

J. E. FRITTS & ASSOC. INC.

Job No. 29C04103 E

Date 4-22-81

Job Access Old Bridge NJ.

Fixed Datum used is

Ground Surface this boring is

DEPTH From	DEPTH To	CLASSIFICATION	Sample & Type No.	Sample Depth		No. of 30" blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in	Last Water or Remarks
		12 M 12-M	SS							
Grd Surface	3'	Dk. Gray & Black organic w/ Gray Gray Sand Layers	1	5'	6.6	4	20	24		H2O Sand
3'	5'	Br. Damp Silty F/m Sand w/ Gravel								
6'	8'	Gray F/ Sand	2	10'	11.6	3	9	11		
8'	13.6'	Wet Tan & Br. F/ Sand								
13.6	18'	Wet Yellow Br. F/ Sand & Silty	3	15'	16.6	3	13	35		
			F	20'	21.6	11	52	50/4"		
18'	27'	Br. F/m Sand w/ Gravel Wet	A	25'	26.6	8	24	36		
			S	30'	31.6	20	28	40		
27'	38'	Gray F/ Silty Wet Sand	F	35'	36.6	14	29	45		
			S	40'	41.6	21	37	45		
38'	43'	Br. F/ Wet Silty Sand	S-7	45'	46.6	11	24	42		
43'	56.6	Gray F/m Wet & Silty Sand	8	50'	51.6	12	19	43		
			F	55'	56.6	17	28	47		
		End Boring								

Installed 56.6' of 2" P.V.C. including 1' stick up
well screen 10'
Sand pack 56' up to 42'
Heavy mud pack 42' up to 2'
Cement casing in 2' up to +1
used 2 1/2 bags sand
12 bags mud
1 bag cement

Ground Surface to ______ ft. used ______ casing.

Water level is ______ ft. below Ground surface at completion.

Water level is ______ ft. below Ground surface ______ hrs. after completion.

Boring stopped by ______

Foreman [signature]

Boring No. 12 M

Form DWR-133
11/80

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

FOR MONITORING PURPOSES ONLY

23-12212 to 23-12236
PERMIT NO. ____
APPLICATION NO. ____
COUNTY Middlesex

WELL RECORD

1. OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ
   Owner's Well No. WCC- 12m SURFACE ELEVATION ____ Feet (Above mean sea level)
2. LOCATION ____
3. DATE COMPLETED 22 Apr 81 DRILLER J.E. Fritts, Co.
4. DIAMETER: Top 10 inches Bottom 10 inches TOTAL DEPTH 56.5 Feet
5. CASING: Type Sch 40 PVC Diameter 2 Inches Length 45 Feet
6. SCREEN: Type Sch 40 PVC Size of Opening 0.020" Diameter 2 Inches Length 10 Feet
   Range in Depth { Top 45 Feet, Bottom 55 Feet } Geologic Formation Raritan
   Tail Piece: Diameter ____ Inches Length ____ Feet
7. WELL FLOWS NATURALLY ____ Gallons per minute at ____ Feet above surface
   Water rises to ____ Feet above surface
8. RECORD OF TEST: Date ____ Yield ____ Gallons per minute
   Static water level before pumping ____ Feet below surface
   Pumping level ____ feet below surface after ____ hours pumping
   Drawdown ____ Feet Specific Capacity ____ Gals. per min. per ft. of drawdown
   How pumped ____ How measured ____
   Observed effect on nearby wells ____
9. PERMANENT PUMPING EQUIPMENT:
   Type ____ Mfrs. Name ____
   Capacity ____ G.P.M. How Driven ____ H.P. ____ R.P.M. ____
   Depth of Pump in well ____ Feet Depth of Footpiece in well ____ Feet
   Depth of Air Line in well ____ Feet Type of Meter on Pump ____ Size ____ Inches
10. USED FOR monitoring AMOUNT { Average ____ Gallons Daily, Maximum ____ Gallons Daily }
11. QUALITY OF WATER ____ Sample: Yes ____ No ____
    Taste ____ Odor ____ Color ____ Temp. ____ °F.
12. LOG descriptive Are samples available? yes
    (Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)
13. SOURCE OF DATA Woodward-Clyde Consultants
14. DATA OBTAINED BY Woodward-Clyde Consultants Date 22 Apr 81

(NOTE: Use other side of this sheet for additio[nal informa]tion such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)

WCC-13m

J. E. FRITTS & ASSOC. INC.

Job No ZC04103

Date 4-20-81

Job Address Old Bridge N.J.

Fixed Datum used is

Ground Surface this boring is

DEPTH From	DEPTH To	CLASSIFICATION	Sample & Type No.	Sample Depth		No. of 30" blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in	Last Water or Remarks
		13 M	S-S							
Grd. Surface	7'	Yellow Br. sand F/m								
1	4	Gray clay organic's								
		Rootts with Grass etc.	1	5'	6.6	1	4	6		4'
4'	13	Brown Tan F/m wet	2	10'	11.6	2	5	7		
		sand	3	15'	16.6	2	5	5		
13	18	Gray-T/Black F/m								
		wet sand T/silty	4	20'	21.6	4	9	14		
18	22	Gray F/m wet sand								
		T/some gravel	5	25'	26.6	7	6	14		
22	28	Gray F/m wet sand	6	30'	31.6	8	17	38		
28'	34	Br. F/m wet sand								
		T/some silty	7	35'-36.6		13	15	32		
34	40	Br. F/m wet sand	8	40'	41.6	18	61	50/4		
40'	44'	F/m T/c wet sand								
		T/black streaks	9	45'	46.5	15	25	50/5		
44	48	Br. F/m wet sand T/silty	10	50'	51.6	16	24	46		
48	53	Gray F/m sand T/silty	11	55'	56.6	15	27	50		
53	56.6	Gray stiff clay								
		END Boring								

Installed 55' 2" PVC w/ 1' stick up

Bottom of screen 54'

Sand pack 55' 45 to 41'

Heavy mud seal 41 to 2'

Installed steel casing around P...

in concrete 2' up to +1'

Foreman [illegible signature]

Ground Surface to ______ ft. used ______ casing.

Water level is ______ ft. below Ground surface at completion.

Water level is ______ ft. below Ground surface ______ hrs. after completion.

Boring stopped by

Boring No. 13 M

Form DWR-121
11/80

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

23-12236
PERMIT NO.
APPLICATION NO.
COUNTY Middlesex

WELL RECORD

1. OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ
Owner's Well No. WCC- 13m SURFACE ELEVATION ____ Feet (Above mean sea level)
2. LOCATION
3. DATE COMPLETED 20 Apr 81 DRILLER J.E. Fritts, Co.
4. DIAMETER: Top 10 inches Bottom 10 inches TOTAL DEPTH 55.5 Feet
5. CASING: Type Sch 40 PVC Diameter 2 Inches Length 44 Feet
6. SCREEN: Type Sch 40 PVC Size of Opening 0.020" Diameter 2 Inches Length 10 Feet
Range in Depth { Top 44 Feet, Bottom 54 Feet } Geologic Formation Raritan
Tail Piece: Diameter ____ Inches Length ____ Feet
7. WELL FLOWS NATURALLY ____ Gallons per minute at ____ Feet above surface
Water rises to ____ Feet above surface
8. RECORD OF TEST: Date ____ Yield ____ Gallons per minute
Static water level before pumping ____ Feet below surface
Pumping level ____ feet below surface after ____ hours pumping
Drawdown ____ Feet Specific Capacity ____ Gals. per min. per ft. of drawdown
How pumped ____ How measured ____
Observed effect on nearby wells ____
9. PERMANENT PUMPING EQUIPMENT:
Type ____ Mfrs. Name ____
Capacity ____ G.P.M. How Driven ____ H.P. ____ R.P.M. ____
Depth of Pump in well ____ Feet Depth of Footpiece in well ____ Feet
Depth of Air Line in well ____ Feet Type of Meter on Pump ____ Size ____ Inches
10. USED FOR monitoring AMOUNT { Average ____ Gallons Daily, Maximum ____ Gallons Daily }
11. QUALITY OF WATER ____ Sample: Yes ____ No ____
Taste ____ Odor ____ Color ____ Temp. ____ °F.
12. LOG descriptive Are samples available? yes
(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)
13. SOURCE OF DATA Woodward-Clyde Consultants
14. DATA OBTAINED BY Woodward-Clyde Consultants Date 20 Apr 81

(NOTE: Use other side of this sheet for addition A-184 ion such as log of materials penetrated, analysis of the water, sketch map, sketc l casing arrangements, etc.)

WCC-15m

J. E. FRITTS & ASSOC. INC.

Job No. 29C04103E

Date 4-21-91

Job Address Old Bridge, N.J.

Fixed Datum used is

Ground Surface this boring is

DEPTH From	DEPTH To	CLASSIFICATION 15m 15M	Sample & Type No	Sample Depth		No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in	Lost Water or Remarks
Grd. Surface	1.6'	Roots Top Soil	SS							
		Straight Auger to 25'								
1.6	25		1	25'	26.6	16	20	27		
25	28	Br. f/m sand wet	2	30'	31.6	12	11	17		
28	38	Br. f/m wet f/silty sand	3	35'	36.6	17	19	20		[illegible] sand
			4	40'	41.6	5	15	31		
38	41	Yellow & Br. f/m wet f/silty sand	5	45'	46.6	5	6	9		
41	44	Gray f/m wet sand f/clayey								
44	49	Br. & Gray f/m wet sand f/clayey	6	50'	51.6	11	13	18		
49	51.6	Dk. Gray stiff clay								
		END of Boring								

Installed 49' 2" PVC. Bottom of Screen 4[illegible]
w/ 1' stickup
Sand Pack 50' up to 34'
Sand Pack 34' up to 2'
Heavy mud Pack 34' up to 2'
Installed steel casing 2' to +1'

Used
2 bags sand mix
1 1/2 bags mud mix
1 1/2 bag concrete

Foreman [signature]

Ground Surface to ____ ft., used ____ casing.

Water level is ____ ft. below Ground surface at completion.

Water level is ____ ft. below Ground surface ____ after completion.

A-185

Boring No. 15m

Boring stopped by

Form DWR-138
1-80

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

23-12212
23-12236

PERMIT NO. ______

APPLICATION NO. ______

COUNTY Middlesex

WELL RECORD

1. OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

Owner's Well No. WCC- 15m SURFACE ELEVATION ______ Feet (Above mean sea level)

2. LOCATION ______

3. DATE COMPLETED 21 Apr 81 DRILLER J.E. Fritts, Co.

4. DIAMETER: Top 10 inches Bottom 10 inches TOTAL DEPTH 51.5 Feet

5. CASING: Type Sch 40 PVC Diameter 2 Inches Length 38 Feet

6. SCREEN: Type Sch 40 PVC Size of Opening 0.020" Diameter 2 Inches Length 10 Feet

Range in Depth { Top 38 Feet / Bottom 48 Feet } Geologic Formation Raritan

Tail Piece: Diameter ______ Inches Length ______ Feet

7. WELL FLOWS NATURALLY ______ Gallons per minute at ______ Feet above surface

Water rises to ______ Feet above surface

8. RECORD OF TEST: Date ______ Yield ______ Gallons per minute

Static water level before pumping ______ Feet below surface

Pumping level ______ feet below surface after ______ hours pumping

Drawdown ______ Feet Specific Capacity ______ Gals. per min. per ft. of drawdown

How pumped ______ How measured ______

Observed effect on nearby wells ______

9. PERMANENT PUMPING EQUIPMENT:

Type ______ Mfrs. Name ______

Capacity ______ G.P.M. How Driven ______ H.P. ______ R.P.M. ______

Depth of Pump in well ______ Feet Depth of Footpiece in well ______ Feet

Depth of Air Line in well ______ Feet Type of Meter on Pump ______ Size ______ Inches

10. USED FOR monitoring AMOUNT { Average ______ Gallons Daily / Maximum ______ Gallons Daily }

11. QUALITY OF WATER ______ Sample: Yes ______ No ______

Taste ______ Odor ______ Color ______ Temp. ______ °F.

12. LOG descriptive Are samples available? yes

(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

13. SOURCE OF DATA Woodward-Clyde Consultants

14. DATA OBTAINED BY Woodward-Clyde Consultants Date 21 Apr 81

(NOTE: Use other side of this sheet for additio A-186 *ition such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)*

APPENDIX E
BORINGS COMPLETED FOR MADISON INDUSTRIES

Converse Consultants, Inc. | TEST BORING LOG | BORING NO. MB

PROJECT	Additional Test Borings							SHT. NO. 1 OF 4
CLIENT	Madison Industries Inc.							PROJ. NO. 81-07135
BORING CONTRACTOR	Warren George Inc.							ELEVATION
GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE	MUD	S.S.			DATE START 1-13-82
				DIA.	4"	2"			DATE FINISH 1-13-82
				WT.		140 #			DRILLER M. Kurzurney
				FALL		30"			CWDD REP. C. Tilley

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
1						
2						
3						
4						
5		S-1	16		Silty sand, gravelly; orange brown, about 15% fine Gravel, coarse to fine sand grains, about 8% non-plastic fines (SW-SM)	
6			22			
			29			
7			21			
8						
9						
10		S-2	9		Silty sand; orange brown, predominate medium sand grains, about 6% non-plastic fines (SP-SM)	
11			18			
			19			
12			19			
13						
14						
15		S-3	16		do.	
16			18			
			23			
17			23			
18					19.5'	
19						
20		S-4	17		Gravelly sand; light gray, coarse to fine sand grains, about 20% fine gravel (SW)	
21			21			
			21		Gravelly sand; light brown, coarse to fine sand grains, about 10% fine gravel (SW)	
22			20			
23						

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS SEE TEXT OF CONVERSE CONSULTANTS REPORT OF WHICH THIS LOG IS A PART

MB1: 1 of 4

Converse Consultants, Inc. | [illegible] | [illegible] MR1

PROJECT: Additional Test Borings | SHT. NO. 2 OF 4

CLIENT: Madison Industries Inc. | PROJ. NO. 81-07-33[illegible]

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
23.5'						
25–27		S-5 A / B	12, 16, 18, 19		Silty sand, gravelly; light gray, coarse to fine sand grains, about 15% slightly plastic fines, about 25% medium to fine gravel (SM)	S-5A
26.0'					Poorly graded sand; light gray, predominate medium sand grains (SP)	S-5B
30–32		S-6	4, 5, 11, 1		Poorly graded sand; light gray, medium to fine sand grains (SP)	S-6
33.5'						
35–37		S-7	8, 9, 11, 15		Clayey silt, sandy; mottled black gray, about 20% medium to fine sand grains in seams, micaceous (ML)	
38.5'						
40–42		S-8	10, 10, 11, 15		Silty sand; light gray, medium to fine sand grains, about 25% nonplastic fines (SM)	
43.5'						
45–47		S-9	6, 8, 11, 16		Poorly graded sand; light gray, medium to fine sand grains (SP)	

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
50		S-10	50 100/2"		Poorly graded sand; light brown, medium to fine sand grains (SP)	
					52.5'	
55		S-11	18 21 23 11		Silty sand, gravelly; light brown, coarse to fine sand grains, about 8 % fines - in clayey silt layers(ML), about 15 % fine Gravel (SW-SM)	
60		S-12	29 61 100/4"		Silty sand, gravelly; light brown, predominately medium sand grains, about 6 % non-plastic fines, about 5 % fine Gravel (SP-SM)	
65		S-13	33 100/4"		do.	
70		S-14	21 100/6"		do.	
75						

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DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
		S-15	100		Silty sand, gravelly; light brown, predominate medium sand grains, about 6% non-plastic fines, about 5% fine Gravel (SP-SM).	
80		S-16	37 100 / 2"		do.	
85		S-17	15 17 13 19		Silty sand, gravelly; orange brown, predominate medium sand grains, about 5% non-plastic fines, about 8% fine gravel (SP-SM) 87.0'	Boring Electrically Logged
90		S-18	20 40 70 100 / 2"		Silty clay; gray, laminated with fine sand lenses, micaceous, inorganic (CL)	Hole Grouted To Surface After Completion.
					End of Boring @ 91.7'	

Converse Consultants, Inc. | TEST BORING LOG | BORING NO. [illegible]

PROJECT	Additional Test Borings							SHT. NO. 1 OF 4
CLIENT	Madison Industries Inc.							PROJ. NO. 81-[illegible]
BORING CONTRACTOR	Warren George Inc.							ELEVATION
GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE	MUD	S.S.			DATE START [illegible]
				DIA.	4"	2"			DATE FINISH [illegible]
				WT.		140 #			DRILLER [illegible]
				FALL		30"			CWOD REP. C. [illegible]

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
1						
2						
3						
4						
5			12		Gravelly sand; orange brown, coarse to fine sand grains, about 15 % fine gravel (SW)	
6		S-1	12 14			
7			15			
8						
9						
10			6		Silty sand; brown, medium to fine sand grains, about 12 % non-plastic fines (SM)	
11		S-2	16 22			
12			20			
13						
14						
15			5		do.	
16		S-3	10 20			
17			25			
18						
19						
20			4		Silty sand; light gray, medium to fine sand grains, about 9 % non-plastic fines (SP-SM)	
21		S-4	6 7			
22			15			
23						

Converse Consultants, Inc. | TEST BORING LOG | BORING NO. 4R-2

PROJECT: Additional Test Borings | SHT. NO. 2 OF 4

CLIENT: Madison Industries Inc. | PROJ. NO. 81-07-93

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
24						
25		S-5	4, 4, 5, 7		Silty sand; mottled brown, medium to fine sand grains, about 12% non-plastic fines (SM)	
26						
27						
28						
29						
30		S-6	5, 21, 37, 42		Silty sand; light gray, coarse to fine sand grains, about 8% non-plastic fines (SW-SM)	
31						
32						
33						
34						
35		S-7	16, 13, 7, 4		Silty sand; light gray, coarse to fine sand grains, about 12% non-plastic fines (SM)	
36						
37						
38						
39						
40		S-8	17, 19, 23, 16		Silty sand; light gray, coarse to fine sand grains, about 8% non-plastic fines (SW-SM)	
41						
42						
43						
44						
45		S-9	33, 70, 100 / 2"		do.	
46						
47						
48						
49						

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Converse Consultants, Inc. | TEST BORING LOG | BORING NO. M TB-1

PROJECT Additional Test Borings | SHT. NO. 3 OF 4

CLIENT Madison Industries Inc. | PROJ. NO. 81-07-33

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
50		S-10	57 100/5"		<u>Well graded sand</u>; light brown, coarse to fine sand grains, about 5% non-plastic fines (SW)	
55		S-11	50 100		do.	
60		S-12	25 100/5"		<u>Poorly graded sand</u>; light brown, medium to fine sand grains, about 5% non-plastic fines (SP)	
65		S-13	100/5"		<u>Poorly graded sand</u>; brown, predominate medium sand grains, about 5% non-plastic fines (SP)	
70		S-14	17 22 23 29		<u>Well graded sand</u>; brown, coarse to fine sand grains, about 5% non-plastic fines (SW) layered with: <u>Silt & clay</u>; gray, micaceous, inorganic (CL)	

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
		S-15	50 63 100 / 3"		do.	
					80.0'	
80		S-16	27 63 100 / 4"		Silt & clay; gray, laminated with fine sand lenses, micaceous, inorganic (CL)	
					83.5'	
85		S-17	70 100 / 5"		Silty sand; light gray, predominate fine sand grains, about 30% slightly plastic fines (SM)	
					88.0'	Boring was elect logged.
90		S-18	39 100 / 5"		Clay & silt sandy; light gray, inorganic, somewhat layered with about 40% fine sand grains (CL)	Borehole grouted surface after completion
					End of boring @ 90.4'	

Converse Consultants, Inc. | TEST BORING LOG 25 | BORING NO. [illegible]

PROJECT	Additional Test Borings						SHT. NO. 1 OF 4
CLIENT	Madison Industries, Inc.						PROJ. NO. [illegible]
BORING CONTRACTOR	Warren George, Inc.						ELEVATION
GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATUM
DATE	TIME	DEPTH	CASING	TYPE	MUD	S.S.			DATE START 1-19-8[illegible]
				DIA.	4"	2"			DATE FINISH 1-2[illegible]-8[illegible]
				WT.		140 #			DRILLER [illegible]
				FALL		30"			CWDD REP. C. [illegible]

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARK
1						
2						
3						
4						
5–7		S-1	6, 6, 9, 10		Silt & clay, sandy; mottled brown, inorganic, about 15 % fine sand grains (ML)	
8						
9						
10–12		S-2	12, 15, 21, 27		Silty sand; mottled black grey, micaceous, slightly organic, about 40 % clayey silt, predominate fine sand grains (SM)	
13						
14						
15–17		S-3	11, 14, 20, 22		Silty sand; grey, slightly organic, predominate fine sand grains, about 25 % non-plastic fines (SM)	
18						
19						
20–21		S-4 A	33, 50		Silty sand; mottled black grey, micaceous, somewhat organic, about 35 % non-plastic fines, predominate medium sand grains (SM)	S-4A
21–22		S-4 B	55, 61		Silty sand; grey, predominate medium sand grains, about 15 % non-plastic fines (SM)	S-4B
23						

Converse Consultants, Inc	TEST BORING LOG	BORING NO. [illegible]
PROJECT Additional Test Borings		SHT. NO. 2 OF 4
CLIENT Madison Industries Inc.		PROJ. NO. 81-07-33

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
					23.5	
24						
25		S-5	33 69 100 / 4"		Poorly graded sand; gray, predominate medium sand grains, about 5 % non-plastic fines (SP)	
26						
27						
28						
29						
30		S-6	30 61 100 / 3"		do.	
31						
32						
33						
34						
35		S-7	11 21 23 20		do.	
36						
37						
38						
39						
40		S-8	7 11 11 14		Poorly graded sand; gray, predominate medium sand grains, about 3 % non-plastic fines (SP)	
41						
42						
43						
44						
45		S-9	35 38 33 30		do.	
46						
47						
48						
49						

Converse Consultants, Inc. | TEST BORING LOG | BORING NO. HB 3

PROJECT: Additional Test Borings | SHT. NO. 3 OF 4

CLIENT: Madison Industries Inc. | PROJ. NO. 81-07133

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
50		S-10	43 23 23 30		do.	
					53.5'	
55		S-11	37 45 47 46		Silt & Clay: gray, inorganic (ML) layered with: Poorly graded sand; gray, predominate medium sand grains, about 3% non-plastic fines (SP)	
					58.5'	
60		S-12	16 22 23 27		Poorly graded sand; light brown, predominate coarse to medium sand grains, about 3% non-plastic fines (SP)	
65		S-13	100		Poorly graded sand; gray, predominate medium sand grains, about 5% non-plastic fines (SP)	
70		S-14	45 100		do.	
					73.0'	

FOR INTERPRETATION OF THIS LOG, REFER TO SUBSURFACE CONDITIONS SECTION OF CONVERSE CONSULTANTS REPORT OF WHICH THIS LOG IS A PART.

Converse Consultants, Inc. | TEST BORING LOG | BORING NO. [illegible]

PROJECT Additional Test Borings | SHT. NO. 4 OF 4

CLIENT Madison Industries Inc. | PROJ. NO. 81-07[illegible]

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
75		S-15	40 100 / 5"		Silty clay; gray, inorganic, laminated with fine sand lenses (CL)	Boring Elec[illegible] Logged
					End of Boring @ 75.9'	Borehole Grout[illegible] Surface.

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THE INTERPRETATION OF SOIL AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT OF WHICH THIS LOG IS A PART

Converse Consultants, Inc. | TEST BORING LOG | BORING NO.

PROJECT Additional Test Borings
CLIENT Madison Industries Inc.
BORING CONTRACTOR Warren George Inc.

SHT. NO. 1 OF 2
PROJ. NO.
ELEVATION
DATUM
DATE START
DATE FINISH
DRILLER
CWDO REP.

GROUND WATER

DATE	TIME	DEPTH	CASING		CAS.	SAMP.	CORE	TUBE
				TYPE	MUD	S.S.		
				DIA.	4"	2"		
				WT.		140 #		
				FALL		30"		

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
5–7		S-1	17, 30, 33, 39		Poorly graded sand; light brown, medium to fine sand grains about 5 % non-plastic fines (SP)	
10–12		S-2	10, 9, 7, 10		Silty sand; gray, coarse to fine sand grains, about 3 % non-plastic fines (SW-SM)	
15–17		S-3	17, 23, 31, 34		Silty sand; light brown, medium to fine sand grains, about 15 % non-plastic fines, occasional siltier layers (SM)	
20–22		S-4	29, 70, 72, 100		Silty sand; light brown, medium to fine sand grains, about 8 % non-plastic fines (SP-SM)	

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS, SEE TEXT OF CONVERSE CONSULTANTS REPORT OF WHICH THIS LOG IS A PART

Converse Consultants, Inc

PROJECT	Additional Test Borings	MB-4
CLIENT	Madison Industries, Inc.	SHT. NO. 2 OF 4
		PROJ. NO. 81-07-33[illegible]

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
24						
25		S-5	33 49 100/5"		Poorly graded sand; light gray, medium to fine sand grains, about 4 % non-plastic fines (SW)	
26						
27						
28						
29						
30		S-6	9 10 25 35		do.	
31						
32						
33						
34						
35		S-7	20 21 23 14		do.	
36						
37						
38					38.5'	
39						
40		S-8	19 24 33 30		Silty sand; light gray, medium to fine sand grains, about 15 % non-plastic fines (SM)	
41						
42						
43						
44						
45		S-9	15 15 22 29		do.	
46						
47						
48					48.5'	
49						

Converse Consultants, Inc. | TEST BORING LOG | BORING NO.

PROJECT: Additional Test Borings | PROJ. NO. 81-07-33

CLIENT: Madison Industries Inc.

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
50		S-10	22 29 40 35		Well graded sand; light gray, coarse to fine sand grains, about 3 % non-plastic fines (SW)	
55		S-11	27 39 63 100 / 4"		Silty sand; light gray, medium to fine sand grains, about 12 % non-plastic fines (SM)	
60		S-12	19 23 35 41		do.	
65		S-13	35 100 / 3"		Poorly graded sand; light brown, predominate medium sand grains, about 5 % non-plastic fines (SP) 69.0'	
70		S-14	19 23 35 41		Silty clay; gray, inorganic, laminated with thin fine sand lenses (CL)	

... THIS REPORT OF WHICH THIS LOG IS A PART

Converse Consultants, Inc. | TEST BORING LOG | BORING NO. HB4

PROJECT Additional Test Borings | SHT. NO. 4 OF 4

CLIENT Madison Industries Inc. | PROJ. NO. 81-[illegible]

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARK
		S-15	12 28 36 44		Silty clay; gray, inorganic, laminated with thin fine sand lenses (CL)	Borehole Grouted to Surface
					End of Boring @ 77.0'	

FOR [illegible] SEE TEXT OF CONVERSE CONSULTANTS REPORT OF WHICH THIS LOG IS A PART

Converse Consultants, Inc. | TEST BORING LOG (1) | BORING NO.

PROJECT	Additional Test Borings
CLIENT	Madison Industries Inc
BORING CONTRACTOR	Warren George Inc
SHT. NO.	1 OF 3
PROJ. NO.	[illegible]
ELEVATION	
DATUM	
DATE START	[illegible]
DATE FINISH	[illegible]
DRILLER	[illegible]
CWCD REP.	W. Brooks

GROUND WATER

DATE	TIME	DEPTH	CASING		CAS.	SAMP.	CORE	TUBE
				TYPE	MUD	S.S.		
				DIA.	4"	2"		
				WT.		140 #		
				FALL		30"		

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11		S-1	1 2 3 7		Poorly graded sand; gray, medium to fine sand grains, about 4% non-plastic fines (SP)	
12						
13						
14						
15						
16						
17						
18						
19						
20						
21		S-2	21 40 100		do.	
22						
23						

Converse Consultants, Inc. | TEST BORING LOG | BORING NO. [illegible]

PROJECT: Additional Test Borings | SHT. NO. 2 OF 3

CLIENT: Madison Industries Inc. | PROJ. NO. 81-07 33-[illegible]

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
24						
25						
26						
27						
28						
29						
30		S-3	60 100 / 4"		do.	
31						
32						
33						
34						
35						
36						
37						
38						
39						
40		S-4	17 26 27 22		Silty sand; orange brown, predominate medium sand grains, about 8 % non-plastic fines (SP-SM)	
41						
42						
43						
44						
45		S-5	24 38 35 31		Poorly graded sand; light gray, predominate medium sand grains, about 3 % non-plastic fines (SP)	
46						
47						
48						
49						

Converse Consultants, Inc. | Test Boring Log

PROJECT	Additional Test Borings	SHT. NO. 3 OF 3
CLIENT	Madison Industries Inc.	PROJ. NO. 81-07[illegible]

DEPTH FT	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
50		S-6	33 33 50 70		do.	
55		S-7	7 20 60 73		do.	
60		S-8	40 100		do.	
					63.0'	
65		A S-9 B	24 23 23 53		Silty sand; orange brown, coarse to fine sand grains, about 15% slightly plastic fines (SM)	
					66.0	
					Clay & silt; gray, inorganic, laminated with thin lenses of fine sand (CL)	
70		S-10	18 42 51 51		do.	Borehole Grouted To Surface
					End of Boring @ 72.0'	

For interpretation of soil, rock and groundwater conditions see text of Converse Consultants report, of which this log is a part.

③ MB-6

PROJECT	Additional Test Borings		SHT. NO. 1 OF 3
CLIENT	Madison Industries - Inc.		PROJ. NO. [illegible]
BORING CONTRACTOR	Warren George Inc.		ELEVATION
GROUND WATER			DATUM

DATE	TIME	DEPTH	CASING		CAS.	SAMP.	CORE	TUBE	
				TYPE	MUD	S.S.			DATE START 1-26-3
				DIA.	4"	2"			DATE FINISH 1-23-3
				WT.		140 #			DRILLER [illegible]
				FALL		30"			CWDD REP. [illegible]

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARK
5–7		S-1	20, 25, 21, 19		Silty sand gravelly; orange brown, coarse to fine sand grains, about 11 % non-plastic fines, about 15 % fine gravel (SW-SM)	
10–12		S-2			Silty sand; gray, medium to fine sand grains, about 5 % non-plastic fines (SP-SM)	
15–17		S-3	13, 19, 22, 20		Poorly graded sand; light gray, medium to fine sand grains, about 3 % non-plastic fines (SP)	
20–21		S-4	45, 100/6"		do.	

FOR INTERPRETATION OF SOIL, ROCK AND GROUNDWATER CONDITIONS SEE TEXT OF CONVERSE CONSULTANTS REPORT OF WHICH THIS LOG IS A PART

Converse Consultants, Inc. | Test Boring [illegible] | 4R6

PROJECT Additional Test Borings | SHT. NO. 2 OF 3

CLIENT Madison Industries Inc. | PROJ. NO. 81-07-133

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
24						
25		S-5	51 40 73 70		do.	
26						
27						
28						
29						
30		S-6	16 16 12 15		do.	
31						
32						
33						
34						
35		S-7	9 11 14 17		do.	
36						
37						
38						
39						
40		S-8	20 30 30 43		do.	
41						
42						
43						
44						
45		S-9	38 51 60 100		Silty sand; light gray, medium to fine sand grains, about 8 % non-plastic fines (SP-SM)	
46						
47						
48						
49						

A-207

Converse Consultants, Inc. | Soil Boring Log

PROJECT: Additional Test Borings | SHT. NO. 3 OF 3

CLIENT: Madison Industries Inc. | PROJ. NO. 81-07-33

DEPTH FT.	CASING BLOWS	SAMPLE NO.	BLOWS ON SAMPLE SPOON PER 6"	SYMBOL	IDENTIFICATION	REMARKS
50		S-10	60 100 / 4"		Poorly graded sand; light brown, coarse to medium sand grains, about 3% non-plastic fines (SP)	
55		S-11	100		Poorly graded sand; gray, coarse to medium sand grains, about 3% non-plastic fines (SP) layered with: Silt & clay; gray, inorganic (ML)	
60		S-12	100		Poorly graded sand; light brown, predominate medium sand grains, about 3% non-plastic fines (SP)	
65		S-13	71 100 / 3"		Well graded sand; light brown, coarse to fine sand grains, about 5% non-plastic fines (SW)	
					68.0'	
70		S-14	22 40 60 69		Silty clay; gray, inorganic, laminated with thin fine sand lenses (CL)	Borehole Grouted To Surface
					End of Boring @ 72.0'	

THE INTERPRETATION OF SOIL ... SEE TEXT OF CONVERSE CONSULTANTS REPORT OF WHICH THIS LOG IS A PART

[illegible] SUCTION WELLS

No. 3 Existing- size 6", depth 58', s.s.screen 15'

Log:
0-10 Yellow to light sand
10-23 Yellow to light gray sand
23-29 clay
29-30 Hard pan
30- 58'10" Coarse gray water sand

Installed 1934
Replaced 1963
Installed submersible pump to sewer - 3/73
State order shut-downs 2/72, 6/73

No 5 Existing- size 6", depth 54', s.s.screen 15'

Log:
0-10 Yellow to light sand
10-23 Yellow to light gray sand
23-29 clay
29-30 Hard pand
30- 58' 10" coarse gray water sand ~~clay~~
58'10"- clay

Installed 7/16/40
Replaced 4/26/63
Shut-downs- 2/72, 6/73

No. 9 Existing- size 6", depth 57', s.s.sczeen 10'

Log:
0-10 light yellow sand
10-23 light gray sand
23-30 clay with small portion gravel
30- 57' 10" gray water sand

57' 10" - clay

Installed 1912
Replaced- 7/40,6/48,11/63
Shut-downs-2/72, 6/73

No. 10 Existing- size 8", depth 61', s.s.screen 15'

Log:
0 -10 Brown sand and gravel
10-42 Lt. Brn. sand streaks white clay
42-47 white - yellow clay
47-65 Fine to coarse lt. brown sand
65-71 White sandy clay

Installed 1911
Replaced 7/26,1957,1963
Shut-downs-2/72,6/73

No. 11 Existing- size 6", depth 52', s.s.screen 15'

Log:
0-13 Dirty yellow sand
13-15 Gray sand
15-19 gray clay
19-27 Brown sand - gravel
27-40 gray sand
40-41 gray clay
41-46 Brown sand
46- 51' 8" gray clay

Installed 1911
Replaced 1952, 1963
Shut-downs 2/72, 6/73

Water Sample 1/1/63

Tot.Sol.	166	ppm
CO_3Hard.	5.5	
Non-CO_3	32.5	
Tot.Hard.	38.0	
Ca Hard.	26.0	
Chloride	5.0	
Alk.M.O.	5.5	
Free Carb.Acid(CO_2)	69.5	
Fe		

No. 13 Existing- size 6", depth 50'?, s.s.screen 8"x10'

Installed 1911
Replaced- 1/2/51, 6/27/57
Shut-down 2/72, 6/73

Log:

0-6	Topsoil & sand
6-9	Gravel & sand
9-11	sand
11-18	sand, clay & gravel
18-21	sand, wood & clay
21-26	sand
26-28	sand & clay balls
28-35	sand pyrite & clay
35-40	coarse sand
40-50	coarse sand & clay balls
50-54	Brn. sand & clay balls
54-58	muddy sand & clay

No. 4 Existing- size 10", depth 38'+
screen L=21'

Installed prior to 1934
Replaced- 1934, 1940

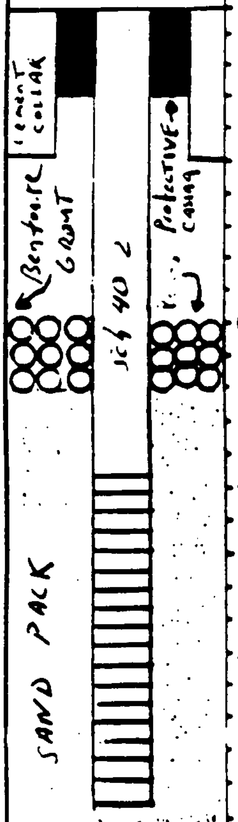
NO LOG

12/1/70- Filled with iron & fibrous white jelly. Sounded to 38'-6" & shut down.

SOURCE: WEHRAN 1989

DW-1S

WEHRAN ENGINEERING CONSULTING ENGINEERS									TEST BORING LOG BORING NO. DW-1S
PROJECT CPS / MADISON AQUIFER REMEDIATION									SHEET NO. 1 OF
CLIENT: CPS / MADISON									JOB NO. [illegible]
BORING CONTRACTOR: ENVIRONMENTAL [illegible]									ELEVATION
GROUND WATER					CAS.	SAMP.	CORE	TUBE	DATE STARTED [illegible]
DATE	TIME	WATER EL.	SCREEN	TYPE	[illegible]				DATE FINISHED [illegible]
[illegible]	[illegible] M.	[illegible].56	14.52 - 24.52	DIA.	[illegible]				DRILLER [illegible]
				WT.					INSPECTOR [illegible]
				FALL					

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0 – 45				REFER TO DW-1D FOR SOIL CLASSIFICATION TOTAL DEPTH 25.0'	W.L.

DW-1D

WEHRAN ENGINEERING CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. DW-1D

PROJECT	DS / MADISON AQUIFER REMEDIATION
CLIENT	DS / MADISON
BORING CONTRACTOR	Environmental Technical Drilling
SHEET NO.	1 OF 2
JOB NO.	06326 HT
ELEVATION	
DATE STARTED	10-24-88
DATE FINISHED	10-24-88
DRILLER	[illegible]
INSPECTOR	D. [illegible]

GROUND WATER

DATE	TIME	WATER EL.	SCREEN
-23	AM	7.77	44.63-54.63

	CAS.	SAMP.	CORE	TUBE
TYPE		S.S.		
DIA.		2"		
WT.		140#		
FALL		30"		

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
Cement Collar; Protective Casing	0–5					
	5–10	1	SS	9, 10, 11, 14	SAND TAN & ORANGE FM SAND, little SILT, trace F. Gravel MEDIUM	W.L.
	10–15	2	SS	8, 13, 12, 10		2" SILT & CLAY STRINGER
Bentonite Grout	15–20	3	SS	13, 10, 12, 11	Tan & ORANGE FM SAND, little + Silt medium	
	20–25	4	SS	25, 26, 27, 30	TAN FMC SAND, little - Gravel, trace silt medium	4-5 Gray Clayey [illegible] stringers
2" Sch 40 FJ PVC	25–30	5	SS	17, 17, 21, 23	Rust FM SAND, [illegible] silt medium	
	30–35	6	SS	21, 25, 35, 37	Tannish GRAY FM SAND, trace Silt DENSE	
Bentonite Pellets	35–40	7	SS	25, 42, 90 50/4"	FMC, trace Silt [illegible] [illegible] FM very dense	2" silty CLAY stringer
	40–45	8	SS	8, 9, 21, 27	FMC SAND, trace silt medium	Clayey [illegible] [illegible]

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. DW-1D

PROJECT: IPS / MADISON LIQUI[illegible] REMEDIATION

CLIENT: IPS / MADISON

SHEET NO. 2 OF 2

JOB NO. 06326 [illegible]

WELL CONSTRUCTION	DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
SAND PACK	45				SAND	
		9	SS	36, 42, 25, 25	TAN FINE SAND TRACE SILT, TRACE F GRAVEL DENSE	2" SILT [illegible] [illegible]
	50				TAN & GRAY FM SAND and Clayey silt	3" CARBONIZED WOOD
		10	SS	7, 10, 11	LOOSE	
	55				TOTAL DEPTH 54'4"	
	60					
	65					
	70					
	75					
	80					
	85					
	90					
	95					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. DW-25

SHEET NO.	1 OF 1
JOB NO.	56326 [illegible]
ELEVATION	
DATE STARTED	[illegible]
DATE FINISHED	[illegible]
DRILLER	[illegible]
INSPECTOR	[illegible]

PROJECT: DPS / MADISON AQUIFER REMEDIATION
CLIENT: DPS / MADISON
BORING CONTRACTOR: Environmental [illegible] Drilling

GROUND WATER

DATE	TIME	WATER EL.	SCREEN
11-[illegible]-83	12 M.	3.34	14.75-24.75

	CAS.	SAMP.	CORE	TUBE
TYPE		SS		
DIA.		2"		
WT.		140#		
FALL		30"		

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
cmt collar; grout; protective csg; 2" sch 40 PVC Riser; bentonite pellets	0				SAND	
	5					
						▼ W.L.
	10	1	SS	6, 7, 9, 8	orangish BROWN FMC SAND, little Silt, trace F Gravel, Loose, wet	
	15	2	SS	4, 5, 10, 15	trace Silt; 15.5'-16.5' bone gray FM SAND and CLAY & SILT; Loose	
sand pack	20	3	SS	13, 23, 26, 29	TAN FMC SAND, little Silt, trace F Gravel, trace Clay & Silt, grading to gray; medium	
	25				TOTAL DEPTH 25.0'	
	30					
	35					
	40					
	45					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. DW-3

PROJECT: CPS / MADISON AQUIFER DELINEATION	SHEET NO. 1 OF 1
CLIENT: CPS / MADISON	JOB NO. 06326
BORING CONTRACTOR: WILSON DRILLING COMPANY	ELEVATION

GROUND WATER

DATE	TIME	WATER EL.	SCREEN

	CAS.	SAMP.	CORE	TUBE
TYPE		SS		
DIA.		2"		
WT.		140#		
FALL		30"		

DATE STARTED [illegible]
DATE FINISHED [illegible]
DRILLER AL Wilson
INSPECTOR [illegible]

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
NATIVE FILL / TEST BORING HOLE BACKFILLED / NATIVE FILL	0				SAND	
	5					Original Boring DW-3 Drilled by AL Wilson Drilling
	10	1		1, 2, 5, 7	Brown FMC SAND, little F Gravel, trace Silt	
	15	2		2, 12, 22, 25	Light Brown FMC SAND, little F Gravel, trace Silt	
	20	3		2, 2, 7, 9		GRAY Silty CLAY stringer
	25	4		3, 7, 9, 21	No Recovery	
	30	5		8, 3, 4, 19	GRAY & Brown FM SAND, trace Silt, trace F Gravel	
		6		8, 22, 30, 15	TOTAL DEPTH 35'	
	40					
	45					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

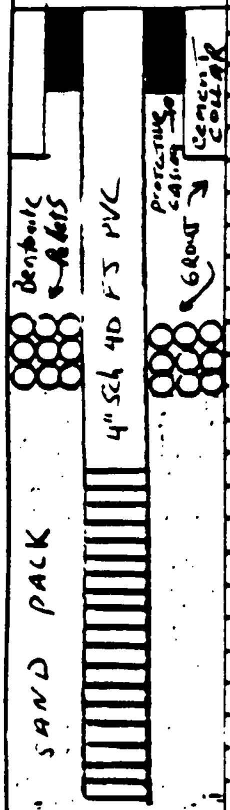
BORING NO.	[illegible]W-3
SHEET NO.	1 OF 1
JOB NO.	[illegible]
ELEVATION	
DATE STARTED	[illegible]
DATE FINISHED	10-14-[illegible]
DRILLER	M[illegible] K[illegible]
INSPECTOR	DCM

PROJECT: [illegible] MADISON [illegible]
CLIENT: CPS MADISON
BORING CONTRACTOR: ENVIRONMENTAL TECHNICAL DRILLING

GROUND WATER

DATE	TIME	WATER EL.	SCREEN
[illegible]	[illegible]	[illegible]	-32 - [illegible]

	CAS.	SAMP.	CORE	TUBE
TYPE	HSA			
DIA.	6.25 ID			
WT.				
FALL				

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0–25				REFER TO DW-3 FOR SOIL CLASSIFICATION TOTAL DEPTH 25'	W.L.
	25–45					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. DW-3D	
PROJECT: CPS / MADISON AQUIFER REMEDIATION	SHEET NO. 1 OF 2
CLIENT: CPS / MADISON	JOB NO. 06326 HC
BORING CONTRACTOR: ENVIRONMENTAL TECHNICAL DRILLING	ELEVATION
	DATE STARTED 10-2-88
	DATE FINISHED 10-4-88
	DRILLER Mike Ryan
	INSPECTOR [illegible]

GROUND WATER

DATE	TIME	WATER EL.	SCREEN
[illegible]	AM	7.76	44.49 - 54.49

	CAS.	SAMP.	CORE	TUBE
TYPE		SS		
DIA.		2"		
WT.		140#		
FALL		30"		

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
protective casing; cmt collar	0				SAND	
	5				REFER TO DW-3 FOR SOIL CLASSIFICATION	W.L.
Sch 40 4" PVC Riser; Bentonite grout	10					
	15					
	20					
	25					
	30					
Bentonite PELLETS	35	7	SS	5, 8, 11, 22	yellowish BROWN FM SAND, trace F Gravel, trace silt medium	
	40	8		23, 45, 62, 90	yellowish BROWN FM SAND, trace silt trace [illegible] to gray	
	45	9		32, 45,	yellowish TAN FM SAND, trace silt dense	

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG
BORING NO. OW-3D

PROJECT: CPS/MADISON AQUIFER REMEDIATION
CLIENT: CPS / MADISON
SHEET NO. 2 OF 2
JOB NO.

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
SAND PACK	50				SAND	
					yellowish BROWN MF SAND, trace - silt	
	55	10	SS	17,35, 33,26		
	60	11	SS	22,37, 52,70	Beige & Gray FM SAND, trace - silt, trace - F Gravel grading → orange & brown	
NATIVE SAND PACK						
	65	12	SS	60 78, 90 87		
		13	SS	44,42, 47,41	Light Gray FM SAND, trace - silt	
					Bone WHITE CLAY & SILT to Silty CLAY	
	70	14	SS	54,70, 81,80		
					END OF BORING 71.0'	
	75					
	80					
	85					
	90					
	95					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

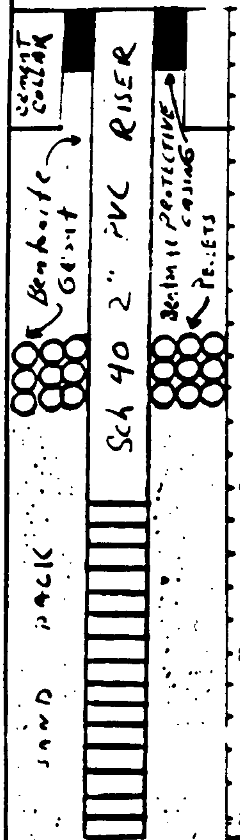
TEST BORING LOG

BORING NO. DW-4S

PROJECT: [illegible]PS / MADISON AQUIFER REMEDIATION	SHEET NO. 1 OF [illegible]
CLIENT: [illegible]PS / MADISON	JOB NO. [illegible]632[illegible] [illegible]
BORING CONTRACTOR: ENVIRONMENTAL TECHNICAL DRILLING	ELEVATION

GROUND WATER					CAS.	SAMP.	CORE	TUBE
DATE	TIME	WATER EL.	SCREEN	TYPE	[illegible]			
[illegible]	A.M.	9.90	15.41 – 25.41	DIA.	[illegible]			
				WT.				
				FALL				

DATE STARTED	[illegible]
DATE FINISHED	[illegible]
DRILLER	[illegible]
INSPECTOR	[illegible]

WELL CONSTRUCTION	DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0–25				REFER TO DW-4D FOR SOIL CLASSIFICATION	W.L.
	25				TOTAL DEPTH 25.41'	
	30–45					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. [illegible]

PROJECT	CDS / MADISON AQUIFER REMEDIATION
CLIENT	CDS / MADISON
BORING CONTRACTOR:	ENVIRONMENTAL TECHNICAL DRILLING
SHEET NO.	1 OF 2
JOB NO.	36326 [illegible]
ELEVATION	
DATE STARTED	[illegible]-2-88
DATE FINISHED	[illegible]-2-88
DRILLER	Mike [illegible]
INSPECTOR	[illegible]

GROUND WATER

DATE	TIME	WATER EL.	SCREEN
[illegible]	A.M.	9.67	44.36 - 54.36

	CAS.	SAMP.	CORE	TUBE
TYPE		SS		
DIA.		2"		
WT.		140#		
FALL		30"		

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
Protective casing; cement collar	0–10				SAND	W.L.
Sch. 40 2" PVC Riser; Grout	10–12	1	SS	33, 50, 55, 42	GRAY FM SAND, trace silt	
	12–16				orange & yellow FM SAND, trace - silt	
	16–18	2	SS	20, 45, 60, 34	orangish BROWN FM SAND, trace - silt DENSE	gray clayey silt stringer
Bentonite	20–22	3	SS	15, 23, 21, 23	orange & TAN FM SAND, trace silt	gray clayey silt [illegible]
	26–28	4	SS	2, 1, 4, 3	yellow & TAN FM SAND, some silt	[illegible]
	31–33	5	SS	11, 15, 36, 41	TAN & BROWN FM SAND, some silt DENSE	[illegible]
Bentonite pellets	36–38	6	SS	30, 39, 40, 38	light BROWN FM SAND, trace silt DENSE	
	41–43	7	SS	27, 34, 41, 47	TAN FM SAND, [illegible] silt Dense	
	46–48	8	SS	41, 115	TAN GRAY F SAND, trace silt Very DENSE	

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. DW-4D

PROJECT: OPSI MADISON AQUIFER REMEDIATION

SHEET NO. 2 OF 2

CLIENT: OPSI MADISON

JOB NO. 06326

WELL CONSTRUCTION	DEPTH IN FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
SAND PACK	45				SAND	
	50	9	SS	32, 46 / 49, 75	Tan Gray F SAND, trace silt, trace F Gravel very Dense	
	55	10	SS	75		
					TOTAL DEPTH 56'4"	
	60					
	65					
	70					
	75					
	80					
	85					
	90					
	95					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. DW-5[illegible]

PROJECT:	CPS / MADISON AQUIFER REMEDIATION
CLIENT:	CPS / MADISON
BORING CONTRACTOR:	ENVIRONMENTAL TECHNICAL DRILLING

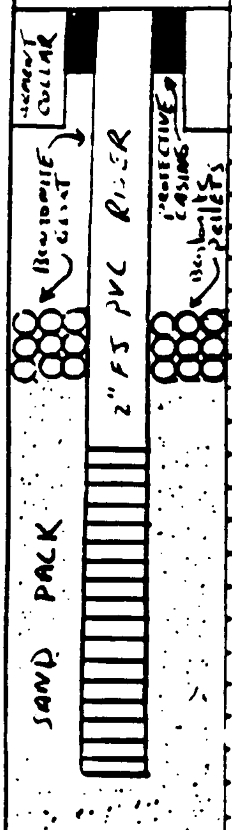
SHEET NO.	1 OF
JOB NO.	06326 HE
ELEVATION	
DATE STARTED	9-24-88
DATE FINISHED	10-24-88
DRILLER	M. RYAN
INSPECTOR	[illegible] McINERNEY

GROUND WATER

DATE	TIME	WATER EL.	SCREEN
11-4-88	A.M.	7.34	13.37 23.87

	CAS.	SAMP.	CORE	TUBE
TYPE	HSA			
DIA.	6.25" ID			
WT.				
FALL				

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS



Depth: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45

REFER TO DW-5D FOR SOIL CLASSIFICATION

W.L.

TOTAL DEPTH 25.5'

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. DW-5D
SHEET NO. 1 **OF** 2
JOB NO. 06326 HE
ELEVATION
DATE STARTED 10-21-98
DATE FINISHED [illegible]
DRILLER MIKE KHAN
INSPECTOR D. McNELNEY

PROJECT: DPS / MADISON AQUIFER REMEDIATION
CLIENT: DPS / MADISON
BORING CONTRACTOR: ENVIRONMENTAL TECHNICAL DRILLING

GROUND WATER					CAS.	SAMP.	CORE	TUBE
DATE	TIME	WATER EL.	SCREEN	TYPE		SS		
[illegible]	L.M.	7.65	40.63-50.63	DIA.		2"		
				WT.		140#		
				FALL		30"		

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
CEMENT COLLAR	0				SAND	
PROTECTIVE CASING	5	1		9, 9, 9	Rusty BROWN FMC SAND, little-Silt, trace-F Gravel LOOSE	DRY; W.L.
Sch. 40 2" FJ PVC RISER	10	2		8, 9, 8, 16	GRAY FMC SAND, some + Silt to Clayey Silt, trace F Gravel MEDIUM	
BENTONITE GROUT	15	3		16, 19, 22, 25		
	20	4		13, 21, 33, 40	GRAY FMC SAND AND CLAY & SILT, trace + Silt, trace F Gravel GRADING TO GRAY FM SAND trace silt	
	25	5		15, 14, 21, 14	GRAY FM SAND, trace silt, trace SILT & CLAY GRADING to GRAY FM SAND, trace Silt	
BENTONITE PELLETS	30	6		8, 10, 13, 20	GRAY FMC SAND, little Silt, trace F Gravel MEDIUM to GRAY FM SAND, trace Silt	
	35	7		10, 19, 21, 24	GRAY FMC SAND, little Silt & CLAY, trace F Gravel to FM SAND, trace silt	
SAND PACK	40	8		12, 16, 25, 10	GRAY FMC SAND, trace silt → clayey silt MEDIUM	
	45	9				

WEHRAN ENGINEERING CONSULTING ENGINEERS	TEST BORING LOG BORING NO. DW-5D
PROJECT: ?PS / MADISON AQUIFER REMEDIATION	SHEET NO. 2 OF 2
CLIENT: ?PS / MADISON	JOB NO. 56326 ??

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
SAND PACK	45				SAND	
		9	SS	7 22 23 23	GRAY FMC SAND, little SILT MEDIUM	
	50					
		10	SS	6 0 62 5"	CLAY Gray CLAY & SILT	
					TOTAL DEPTH 53'	
	55					
	60					
	65					
	70					
	75					
	80					
	85					
	90					
	95					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

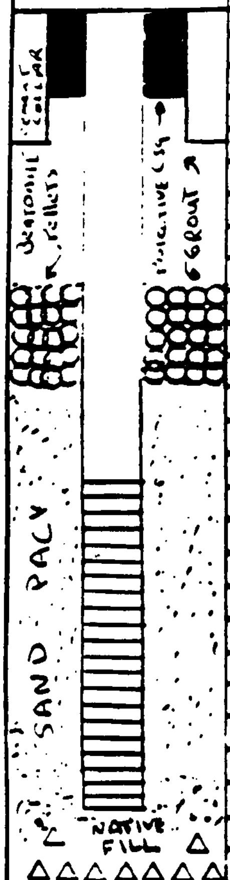
BORING NO. DW-6S

PROJECT: CPS / MADISON [illegible] REMEDIATION	SHEET NO. 1 OF 1
CLIENT: CPS MADISON	JOB NO. [illegible]
BORING CONTRACTOR: ENVIRONMENTAL TECHNICAL DRILLING	ELEVATION
	DATE STARTED [illegible]
	DATE FINISHED [illegible]
	DRILLER [illegible]
	INSPECTOR [illegible]

GROUND WATER

DATE	TIME	WATER EL.	SCREEN
[illegible]	[illegible]	[illegible].56	14.80 - 24.80

	CAS.	SAMP.	CORE	TUBE
TYPE	HSA			
DIA.	[illegible]			
WT.				
FALL				

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0 – 27				REFER TO DW-6D FOR SOIL CLASSIFICATION TOTAL DEPTH 27'	W.L.

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. OW-6D
SHEET NO. 1 OF 2
JOB NO. 06326
ELEVATION
DATE STARTED 0-3-88
DATE FINISHED 10-8-88
DRILLER M. RYAN
INSPECTOR D. McNeney

PROJECT: ?PS / MADISON AQUIFER REMEDIATION
CLIENT: ?PS / MADISON
BORING CONTRACTOR: ENVIRONMENTAL TECHNICAL DRILLING

GROUND WATER

DATE	TIME	WATER EL.	SCREEN
-38	9 AM	6.32	45.68 - 55.08

	CAS.	SAMP.	CORE	TUBE
TYPE		SS		
DIA.		2"		
WT.		140#		
FALL		30"		

WELL CONSTRUCTION: CEMENT COLLAR; PROTECTIVE CASING; BENTONITE GROUT; SCH 40 FJ 2" PVC RISER; BENTONITE PELLETS

DEPTH FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0–10				SAND	W.L.
10	1	SS	9, 11, 13, 14	YELLOW & ORANGE FMC SAND, trace+ Silt, trace F Gravel. LOOSE	
15	2		19, 26, 24, 33	YELLOW & ORANGE FMC SAND, little F Gravel, trace Silt. MEDIUM	
20				GRAY FM SAND, trace + F Gravel, trace Silt	
20	3		26, 52, 64, 58	ORANGE & BROWN FMC SAND, trace - F Gravel, trace Silt. Dense	
25	4		25, 38, 40, 40	GRAY FM SAND, trace Silt. Dense	One CLAY & SILT Stringer
30	5		14, 13, 16, 19	... BROWN FM SAND, trace Silt	
				GRAY Silty CLAY VARVED DENSE	
35	6		33, 49, 58, 75	Bone GRAY FMC SAND, trace Silt. DENSE	Bone CLAY & S... Stringer
40	7		17, 20, 23, 42	Light GRAY FMC SAND, trace Silt, trace F Gravel. MEDIUM	One GRAY ... Stringer
45					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG
BORING NO. [illegible]W-6 [illegible]
SHEET NO. 2 OF 2
JOB NO. [illegible]6326 HT

PROJECT: [illegible]PS / MADISON AQUIFER REMEDIATION
CLIENT: [illegible]PS / MADISON

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
SAND PACK	45	8	SS	26, 50/5"	[illegible] FMC SAND, trace F Gravel / Gray F SAND, [illegible] Silt, very DENSE	Gray Clayey Silt stringer
	50	9		43, 43, 25, 33	GRAY FM SAND, trace Silt, trace F Gravel, grading to F SAND, DENSE	Gray Clayey Silt stringer
	55				TOTAL DEPTH 55.68'	
	60					
	65					
	70					
	75					
	80					
	85					
	90					
	95					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG
BORING NO. DW-7S

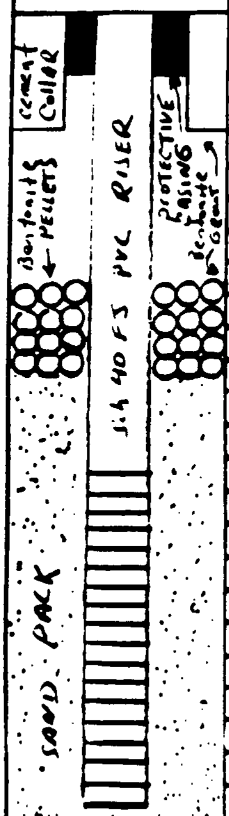
PROJECT	CPS / MADISON AQUIFER REMEDIATION
CLIENT	CPS / MADISON
BORING CONTRACTOR	ENVIRONMENTAL TECHNICAL DRILLING

SHEET NO. 1 OF	
JOB NO.	06326
ELEVATION	
DATE STARTED	10-26-88
DATE FINISHED	10-26-88
DRILLER	RYAN
INSPECTOR	D. McNEENEY

GROUND WATER

DATE	TIME	WATER EL.	SCREEN
11-4-88	A.M.	10.10	14.62 – 24.62

	CAS.	SAMP.	CORE	TUBE
TYPE				
DIA.				
WT.				
FALL				

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	SAMPLE BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	0–25				REFER TO DW-7D FOR SOIL CLASSIFICATION	W.L.
	25				TOTAL DEPTH 25.0'	
	30, 35, 40, 45					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO.	OW-7D
SHEET NO.	1 OF 2
JOB NO.	02326
ELEVATION	
DATE STARTED	2-25-88
DATE FINISHED	2-26-88
DRILLER	[illegible]
INSPECTOR	[illegible]

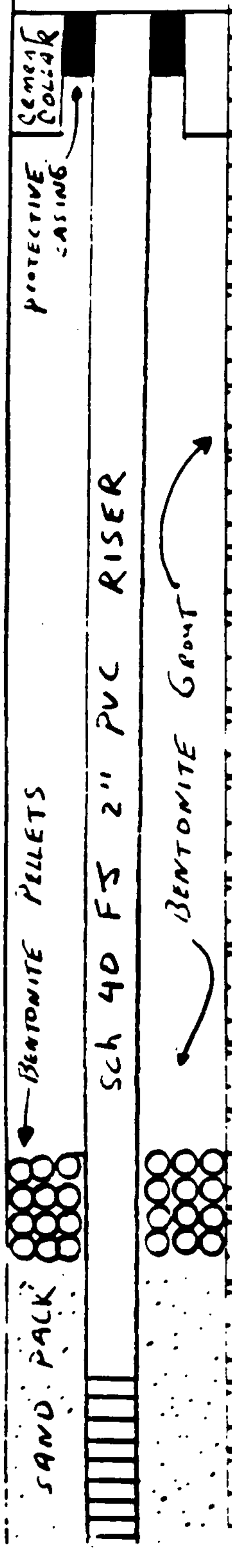
PROJECT: DPS MADISON AQUIFER REMEDIATION

CLIENT: DPS MADISON

BORING CONTRACTOR: ENVIRONMENTAL TECHNICAL DRILLING

GROUND WATER			
DATE	TIME	WATER EL.	SCREEN
11-4-88	A.M.	12.54	41.52 - 51.52

	CAS.	SAMP.	CORE	TUBE
TYPE		SS		
DIA.		2"		
WT.		140#		
FALL		30"		



DEPTH FEET	SAMPLE NO.	TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
0				SAND	
5–10	1	SS	6, 5, 5, 8	Orange & Brown FM SAND, little Silt Loose	Dry
10					W.T.
10–15	2	SS	11, 13, 19, 17	Tannish ORANGE FMC SAND, little F Gravel, trace Silt MEDIUM	
15			14, 26, 35, 43		
15–20	3	SS	14, 26, 35, 43	TAN FMC SAND, trace Silt	
				FM GRAVEL AND FMC SAND	
20				TAN FM SAND, trace Silt grading to Fine	
20–25	4	SS	9, 14, 15	Tan Brown FMC SAND, some F Gravel, trace Silt to CLAY FM SAND, little Silt MEDIUM	
25–30	5	SS	20, 36, 38, 57	Tan & Gray FMC SAND, little F Gravel, trace Silt	Clayey Silt stringer
30–35	6	SS	33, 45, 55, 50	Tan & Gray FMC SAND, trace Silt Dense	
35					Some Silty CLAY Stringers
35–40	7	SS	13, 19, 26, 24	Tannish CLAY FM SAND, little Silt MEDIUM	
40–45	8	SS	28, 30, 33, 52	CLAY MC SAND, trace Silt DENSE	Some Clayey Stringers
45					

WEHRAN ENGINEERING
CONSULTING ENGINEERS

TEST BORING LOG

BORING NO. DN-7D

SHEET NO. 2 OF 2

JOB NO. 06326 4C

PROJECT: CPS / MADISON AQUIFER REMEDIATION

CLIENT: CPS / MADISON

WELL CONSTRUCTION	DEPTH FEET	SAMPLE NO.	SAMPLE TYPE	BLOWS PER 6 INCHES	CLASSIFICATION	REMARKS
	45					
		9	SS	22 17, 9 5	GRAY [illegible] SAND [illegible] trace [illegible] SILT MEDIUM	
	50					
		10	SS	5, 13, 22 : 8	Bone white CLAY SILTY CLAY to CLAY	
					Total Depth 53'8"	
	55					
	60					
	65					
	70					
	75					
	80					
	85					
	90					
	95					

NCC

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

PERMIT NO. ____

APPLICATION NO. ____

COUNTY Middlesex

WELL RECORD

OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

Owner's Well No. WCC-1d SURFACE ELEVATION ____ Feet (Above mean sea level)

LOCATION ____

DATE COMPLETED 6 Jan 81 DRILLER J.E. Fritts, Co.

DIAMETER: Top 6 inches Bottom 6 inches TOTAL DEPTH 101 Feet

CASING: Type Sch 40 PVC Diameter 2 Inches Length 91 Feet

SCREEN: Type Sch 40 PVC Size of Opening 0.020 Diameter 2 Inches Length 10 Feet

Range in Depth: Top 91 Feet, Bottom 101 Feet Geologic Formation Raritan

Tail Piece: Diameter ____ Inches Length ____ Feet

WELL FLOWS NATURALLY ____ Gallons per minute at ____ Feet above surface

Water rises to ____ Feet above surface

RECORD OF TEST: Date ____ Yield ____ Gallons per minute

Static water level before pumping ____ Feet below surface

Pumping level ____ feet below surface after ____ hours pumping

Drawdown ____ Feet Specific Capacity ____ Gals. per min. per ft. of drawdown

How pumped ____ How measured ____

Observed effect on nearby wells ____

PERMANENT PUMPING EQUIPMENT:

Type ____ Mfrs. Name ____

Capacity ____ G.P.M. How Driven ____ H.P. ____ R.P.M. ____

Depth of Pump in well ____ Feet Depth of Footpiece in well ____ Feet

Depth of Air Line in well ____ Feet Type of Meter on Pump ____ Size ____ Inches

USED FOR monitoring AMOUNT: Average ____ Gallons Daily, Maximum ____ Gallons Daily

QUALITY OF WATER ____ Sample: Yes ____ No ____

Taste ____ Odor ____ Color ____ Temp. ____ °F.

LOG descriptive Are samples available? yes

(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

SOURCE OF DATA Woodward-Clyde Consultants

DATA OBTAINED BY Woodward-Clyde Consultants Date 6 Jan 81

(NOTE: Use other side of this sheet for additional information such as log of materials penetrated.)

WCC-1d

J. E. FRITTS & ASSOC. INC.

: 1-5-[illegible] Job No. 1-[illegible]

Address C.P.S. Old Bridge N.J.

ed Datum used is

Ground Surface this boring is

Depth From	To	Classification ID	Sample & Type No.	Sample Depth	No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in	Remarks
Grd. Surface	2'	Brown + Black Fine Sand							
2'	7'	Gray Fine Sand	S-1	4'6"-6'	1	3	8		[illegible]
7'	19'	Brown Fine To Med							
		Wet Sand + Gravel	S-2	7'6"-9'	5	8	12		
		Incounter Water At 10'	S-3	14'6"-16'	8	2	12		
19'	29'	Brown Fine Sand	S-4	19'6"-21'	5	8	10		
			S-5	24'6"-26'	4	7	9		
29'	34'	Brown Very Fine	S-6	29'6"-31'	W.O.R				
		Sand, Traces of Clay							
34'	39'	Brown + Gray Fine Sand	S-7	34'6"-36'	10	29	20		
39'	44'	Brown Gray Fine Sand	S-8	39'6"-41'	4	6	19		
		Traces of Small Gravel							
44'	49'	Light Brown Fine Sand	S-9	44'6"-45'6"	22	50			
49'	64'	Brown With Layers	S-10	49'6"-51'	4	6	9		
		of Fine Sand	S-11	54'6"-55'10"	18	45	50/4"		
64	70'	Lt. [illegible] Some Black Gray	12	59.6-61	11	16	18		
		F/sand & F/clay trace	13	64.6-66	7	14	17		
70	80	Gray F/ Sand	F. 14	69.6-70.2	33	59		0	
80	84	Lt. F/ sand & F/gravel	wash 15	75'	—				
84'	90'	Orange & Lt. Gr. [illegible]/silty F/	16	80'	—				
		Sand	17	85-86.5	7	36	54/5		
90'	95	Gray F/c sand & F/gravel	18	90'	—	wash sample			
		T/ clay	18A	90'-91.6	8	10	24		
95	100'	Gray F/m sand some Black	19'	95'	—	wash sample			
		Streaks							
100	101.4	Gray stiff clay almost	20	100'-101.4	20	37	64/4"		
		Dry w/ F/ sand seams							

Ground Surface to ______ ft. used ______ casing.

Water level is ______ ft. below Ground surface at completion.

Water level is ______ ft. below Ground surface ______ A-232 completion.

Boring stopped by ______

Foreman [illegible]

Boring No. B1A

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

PERMIT NO. [illegible]

APPLICATION NO. [illegible]

COUNTY Middlesex

WELL RECORD

OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

Owner's Well No. WCC- 2M SURFACE ELEVATION ______ Feet (Above mean sea level)

LOCATION ______

DATE COMPLETED 20 Jan 81 DRILLER J.E. Fritts, Co.

DIAMETER: Top 6 inches Bottom 6 inches TOTAL DEPTH 56 Feet

CASING: Type Sch 40 PVC Diameter 2 Inches Length 46 Feet

SCREEN: Type Sch 40 PVC Size of Opening 0.020 Diameter 2 Inches Length 10 Feet

Range in Depth: Top 46 Feet; Bottom 56 Feet

Geologic Formation Raritan

Tail Piece: Diameter ______ Inches Length ______ Feet

WELL FLOWS NATURALLY ______ Gallons per minute at ______ Feet above surface

Water rises to ______ Feet above surface

RECORD OF TEST: Date ______ Yield ______ Gallons per minute

Static water level before pumping ______ Feet below surface

Pumping level ______ feet below surface after ______ hours pumping

Drawdown ______ Feet Specific Capacity ______ Gals. per min. per ft. of drawdown

How pumped ______ How measured ______

Observed effect on nearby wells ______

PERMANENT PUMPING EQUIPMENT:

Type ______ Mfrs. Name ______

Capacity ______ G.P.M. How Driven ______ H.P. ______ R.P.M. ______

Depth of Pump in well ______ Feet Depth of Footpiece in well ______ Feet

Depth of Air Line in well ______ Feet Type of Meter on Pump ______ Size ______ Inches

USED FOR monitoring

AMOUNT: Average ______ Gallons Daily; Maximum ______ Gallons Daily

QUALITY OF WATER ______ Sample: Yes ______ No ______

Taste ______ Odor ______ Color ______ Temp. ______ °F.

LOG descriptive Are samples available? yes

(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

SOURCE OF DATA Woodward-Clyde Consultants

DATA OBTAINED BY Woodward-Clyde Consultants Date 20 Jan 81

(NOTE: Use other side of this sheet for additional information such as log of materials penetrated.)

WCC-2m

J. E. FRITTS & ASSOC. INC.

[illegible]-20-80

Job No.

Address Old Bridge, N.J.

Fixed Datum used is

Ground Surface this boring is

DEPTH From	DEPTH To	CLASSIFICATION 2M	Sample & Type No.	Sample Depth		No. of 30" blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in	Last ... Remarks
Grd Surface	20'	Brown Fine Tamed	S-1	5'	6'6"	10	25	19		[illegible]
		Sand + Gravel	S-2	10'	11'6"	3	6	4		
		~~[illegible]~~	S-3	15'	16'6"	7	12	19		
		Encounter water at 5'	S-4	20'	21'6"	4	6	6		S[illegible]
20'	30'	Gray Fine Sand	S-5	25'	26'6"	7	7	8		
		with Layers of Brown								
30'	40'	Black to Gray Silty	S-6	30'	31'6"	4	5	6		
		Fine Sand	S-7	35'	36'6"	4	6	12		
40'	55'	Brown Fine Tamed Sand	S-8	40'	41'6"	6	21	40		S[illegible]
			S-9	45'	46'6"	16	36	34		
			S-10	50'	51'6"	9	9	26		S[illegible]
55'	55'7"	Brown Gray Silty Fine	S-11	55'	55'7"	80/2"	50/3"			S[illegible]
		Sand with Mod Sand.								

Installed 55' 2" P.V.C. Screen 45 - 55'
w/ Sand Pack to 42' to 55' & Mud [illegible]
42' up to top of Hole

Ground Surface to ______ ft. used ______ casing.

Water level is ______ ft. below Ground surface at compl. A-234

Water level is ______ ft. below Ground surface ______ hrs. after completion.

Boring stopped by ______

Foreman E. [illegible]

Boring No. B-2

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

PERMIT NO.

APPLICATION NO. ______

COUNTY Middlesex

WELL RECORD

OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

Owner's Well No. WCC-3D SURFACE ELEVATION ______ Feet (above mean sea level)

LOCATION ______

DATE COMPLETED 6 Jan 81 DRILLER J.E. Fritts, Co.

DIAMETER: Top 6 inches Bottom 6 inches TOTAL DEPTH 81 Feet

CASING: Type Sch 40 PVC Diameter 2 Inches Length 84 Feet

SCREEN: Type Sch 40 PVC Size of Opening 0.020 Diameter 2 Inches Length 10 Feet

Range in Depth: Top 71 Feet, Bottom 81 Feet Geologic Formation Raritan

Tail Piece: Diameter ______ Inches Length ______ Feet

WELL FLOWS NATURALLY ______ Gallons per minute at ______ Feet above surface

Water rises to ______ Feet above surface

RECORD OF TEST: Date ______ Yield ______ Gallons per minute

Static water level before pumping ______ Feet below surface

Pumping level ______ feet below surface after ______ hours pumping

Drawdown ______ Feet Specific Capacity ______ Gals. per min. per ft. of drawdown

How pumped ______ How measured ______

Observed effect on nearby wells ______

PERMANENT PUMPING EQUIPMENT:

Type ______ Mfrs. Name ______

Capacity ______ G.P.M. How Driven ______ H.P. ______ R.P.M. ______

Depth of Pump in well ______ Feet Depth of Footpiece in well ______ Feet

Depth of Air Line in well ______ Feet Type of Meter on Pump ______ Size ______ Inches

USED FOR monitoring AMOUNT: Average ______ Gallons Daily, Maximum ______ Gallons Daily

QUALITY OF WATER ______ Sample: Yes ______ No ______

Taste ______ Odor ______ Color ______ Temp. ______ °F.

LOG descriptive Are samples available? yes

(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

SOURCE OF DATA Woodward-Clyde Consultants

DATA OBTAINED BY Woodward-Clyde Consultants Date 6 Jan 81

NOTE: Use other side of this sheet for additional information such as log of materials penetrated.

WCC-3d

J. E. FRITTS & ASSOC. INC.

Date 1-6-91

Job No.

Job Address Old Bridge, N.J.

Fixed Datum used is

Ground Surface this boring is

Depth From	Depth To	Classification 3D	Sample & Type No.	Sample Depth		No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in	Remarks
Grd. Surface	2'	Brown sand, gravel + small black topsoil								
2'	5'	Dark brown fine sand	S-1	2'	3'6"	5	9	13		
5'	10'	Brown + gray fine sand, traces of silt	S-2	5'	6'6"	7	11	18		
			S-3	8'	9'6"	5	8	5		
		Incounter water 8'6"								
10'	15'	Gray fine to med sand, traces of gravel	S-4	10'6"	12'	3	4	12		
15'	29'6"	Gray fine to med sand	S-5	15'	16'6"	14	34	25		
			S-6	20'	21'6"	7	11	22		
			S-7	25'	26'6"	8	20	33		
29'6"	40'	Gray fine to med sand traces of silt	S-8	30'	31'6"	6	37	50/3"		
			S-9	35'	36'3"	13	36	50/3"		
40'	49'6"	Gray fine to med sand	S-10	40'	41'3"	8	33	50/3"		
			S-11	45'	46'3"	16	43	50/5"		
49'6"	56'	Gray silty clay	S-12	50'	51'6"	16	32	31		2 Samp
			S-13A	55'	56'6"	7	13	27		
56'	60'	Gray black sandy silt with small traces of mica	S-13B	55'	56'6"	7	13	27		
60'	70'	Gray silty clay	S-14	60'	61'6"	8	15	25		2 Sam
			S-15	65'	66'6"	6	9	14		
70'	75'	Gray + brown fine to med sand	S-16	70'	71'6"	5	6	6		
75'	80'	Brown fine to med sand traces of sandy clay	S-17	75'	76'3"	10	20	50/3"		
80'	80'6"	Brown fine sand	S-18	80'		36	50/3	?		

Installed 10' screen + 74' 2" PVC pipe total 84'

3' stick up from ground

Ground Surface to ______ ft. used ______ casing. A-236

Water level is ______ ft. below Ground surface at completion.

Water level is ______ ft. below Ground surface ______ hrs. after completion.

Foreman Miller + Thorn

Boring No. B-3A

FOR MONITORING PURPOSES ONLY

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

PERMIT NO. ______

APPLICATION NO. ______

COUNTY Middlesex

WELL RECORD

OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

Owner's Well No. WCC-6D SURFACE ELEVATION ______ Feet (Above mean sea level)

LOCATION ______

DATE COMPLETED 12 Jan 81 DRILLER J.E. Fritts, Co.

DIAMETER: Top 6 inches Bottom 6 inches TOTAL DEPTH 80 Feet

CASING: Type Sch 40 PVC Diameter 2 Inches Length 65 Feet

SCREEN: Type Sch 40 PVC Size of Opening 0.020 Diameter 2 Inches Length 10 Feet

Range in Depth { Top 65 Feet / Bottom 75 Feet } Geologic Formation Raritan

Tail Piece: Diameter 2 Inches Length 5 Feet

WELL FLOWS NATURALLY ______ Gallons per minute at ______ Feet above surface

Water rises to ______ Feet above surface

RECORD OF TEST: Date ______ Yield ______ Gallons per minute

Static water level before pumping ______ Feet below surface

Pumping level ______ feet below surface after ______ hours pumping

Drawdown ______ Feet Specific Capacity ______ Gals. per min. per ft. of drawdown

How pumped ______ How measured ______

Observed effect on nearby wells ______

PERMANENT PUMPING EQUIPMENT:

Type ______ Mfrs. Name ______

Capacity ______ G.P.M. How Driven ______ H.P. ______ R.P.M. ______

Depth of Pump in well ______ Feet Depth of Footpiece in well ______ Feet

Depth of Air Line in well ______ Feet Type of Meter on Pump ______ Size ______ Inches

USED FOR monitoring AMOUNT { Average ______ Gallons Daily / Maximum ______ Gallons Daily }

QUALITY OF WATER ______ Sample: Yes ______ No ______

Taste ______ Odor ______ Color ______ Temp. ______ °F.

LOG descriptive Are samples available? yes

(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

SOURCE OF DATA Woodward-Clyde Consultants

DATA OBTAINED BY Woodward-Clyde Consultants Date 12 Jan 81

(NOTE: Use other side of this sheet for additional information such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)

WCC-6d

J. E. FRITTS & ASSOC. INC.

Date 1-12-81 Job No. [illegible]

Address Old Bridge, N.J.

Datum used is 5" I.D. Auger

Ground Surface this boring is

CLASSIFICATION 6-D

Depth From	Depth To	Classification	Sample & Type No.	Sample Depth		No. of 30" blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery in	Remarks
Grd. Surface	14'6"	Brown Fine To Coarse	S-1	4'6"	6'	9	7	4		
		Sand with Pebbles	S-2	9'6"	11'	10	11	14		
14'6"	34'	Gray med Sand	S-3	14'6"	16'	3	3	8		
			S-4	19'6"	21'	7	10	34		
			S-5	24'6"	26'	8	16	24		WAS TI
			S-6	29'6"	31'	7	9	13		10
34'	39'	Gray Fine med Sand	S-7	34'6"	36'	11	12	15		15
		Traces of silty clay								
39'	57'	Grayish white Fine Sand	S-8	39'6"	40'6"	18	50/6"			
			S-9	44'6"	46'	7	11	11		10
			S-10	49'6"	51'	16	24	37		
			S-11	54'6"	56'	8	20	34		
57'	74'	Light Brown Fine sand	S-12	59'6"	61'	13	15	24		10
			S-13	64'6"	66'	10	8	10		
			S-14	69'6"	71'	13	9	9		
74'	76.6	Brown + Gray Fine sand	S-15	74'6"	75'6"	38	100/6"			15
		with layers of silty clay	16	79.6	80.6	14	100/6"			
76.6	80.6	Br. + Gray F/sand +								

Ground Surface to ______ ft. used ______ casing.

Water level is ______ ft. below Ground surface at completion.

Foreman E. Higinee

Form DWR-103
[illegible]

23-12236

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

FOR MONITORING PURPOSES ONLY

PERMIT NO ______

APPLICATION NO ______

COUNTY Middlesex

WELL RECORD

1. OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

   Owner's Well No. WCC- 11d SURFACE ELEVATION ______ Feet (Above mean sea level)

2. LOCATION ______

3. DATE COMPLETED 16 Apr 81 DRILLER J.E. Fritts, Co.

4. DIAMETER: Top 10 inches Bottom 10 inches TOTAL DEPTH 71.5 Feet

5. CASING: Type Sch 40 PVC Diameter 2 Inches Length 55 Feet

6. SCREEN: Type Sch 40 PVC Size of Opening 0.020" Diameter 2 Inches Length 10 Feet

   Range in Depth { Top 55 Feet; Bottom 65 Feet } Geologic Formation Raritan

   Tail Piece: Diameter 2 Inches Length 5 Feet

7. WELL FLOWS NATURALLY ______ Gallons per minute at ______ Feet above surface

   Water rises to ______ Feet above surface

8. RECORD OF TEST: Date ______ Yield ______ Gallons per minute

   Static water level before pumping ______ Feet below surface

   Pumping level ______ feet below surface after ______ hours pumping

   Drawdown ______ Feet Specific Capacity ______ Gals. per min. per ft. of drawdown

   How pumped ______ How measured ______

   Observed effect on nearby wells ______

9. PERMANENT PUMPING EQUIPMENT:

   Type ______ Mfrs. Name ______

   Capacity ______ G.P.M. How Driven ______ H.P. ______ R.P.M. ______

   Depth of Pump in well ______ Feet Depth of Footpiece in well ______ Feet

   Depth of Air Line in well ______ Feet Type of Meter on Pump ______ Size ______ Inches

10. USED FOR monitoring AMOUNT { Average ______ Gallons Daily; Maximum ______ Gallons Daily }

11. QUALITY OF WATER ______ Sample: Yes ______ No ______

    Taste ______ Odor ______ Color ______ Temp. ______ °F.

12. LOG descriptive Are samples available? yes

    (Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

13. SOURCE OF DATA Woodward-Clyde Consultants

14. DATA OBTAINED BY Woodward-Clyde Consultants Date 16 Apr 81

(NOTE: Use other side of this sheet for additional information such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)

WCC-11d

* USED 5½ [illegible] SAND
1½ bag
2 bags CEMENT

J. E. FRITTS & ASSOC. INC.

Job No. 29C0410JE

Date 4-16-91

Job Address Old Bridge, N.J.

Fixed Datum used is

Ground Surface this boring is

Depth From	Depth To	Classification 11D 11-D	Sample & Type No. SS	Sample Depth		No. of 30 Blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery	Remarks
Grd. Surface	1.6'	TOP SOIL								
1.6	25'	STRAIGHT AUGER	1	25'	26.6	10	25	32		
25	29'	Br. & Gray F/M WET SAND	2	30'	31.6	1	2	6		
29'	33	Gray Silty F/M SAND								
33	39	Gray, Br. WET F/M SAND & Silty	3	35'	36.6	17	25	28		
39'	43'	Gray Silty F/M WET SAND	4	40'	41.6	7	11	24		
43	48'	Tan To Br. F/M Silty WET SAND	5	45	46.6	12	29	48		
48	54	F/Gray F/M WET SAND Some Silt	6	50'	51.6	18	60	50/4"		
54	64	Gray M/To F/ SAND WET	7	55'	56.6	10	26	39		
64	67'	ORANGE & Br. F/M WET CLAYEY SAND	8	60'	61.6	13	62	50/4"	0	
67	71.6	Gray STIFF CLAY DRY	8	65'	66.6	24	31	50		
			9	70'	71.6	17	26	29		

- END of Boring -

INSTALLED 68' - 2" P.V.C. & SCREEN Total Length [illegible]
SAND PACK 70' TO 52' w/ Bottom of Screen
AT 68'
MUD PACK 52' UP TO 2' Heavy Mud
CEMENT PACK w/ STEEL CASING 2' UP T[illegible]
0' w/ 1' STICK UP of CASING

Foreman [illegible signature]

Ground Surface to ______ ft. used ______ casing.

Water level is ______ ft. below Ground surface at co

Water level is ______ ft. below Ground surface ______ A-240 after completion.

Boring No. 11D

Boring stopped by ______

Form DWR-138
11 80

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

23-[illegible]
23-[illegible]

PERMIT NO. ____

APPLICATION NO. ____

COUNTY Middlesex

FOR MONITORING PURPOSES ONLY

WELL RECORD

1. OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

   Owner's Well No. WCC-1Cm SURFACE ELEVATION ____ Feet (Above mean sea level)

2. LOCATION ____

3. DATE COMPLETED 22 Apr 81 DRILLER J.E. Fritts, Co.

4. DIAMETER: Top 10 inches Bottom 10 inches TOTAL DEPTH 56.5 Feet

5. CASING: Type Sch 40 PVC Diameter 2 Inches Length 45 Feet

6. SCREEN: Type Sch 40 PVC Size of Opening 0.020" Diameter 2 Inches Length 10 Feet

   Range in Depth { Top 45 Feet, Bottom 55 Feet } Geologic Formation Raritan

   Tail Piece: Diameter ____ Inches Length ____ Feet

7. WELL FLOWS NATURALLY ____ Gallons per minute at ____ Feet above surface

   Water rises to ____ Feet above surface

8. RECORD OF TEST: Date ____ Yield ____ Gallons per minute

   Static water level before pumping ____ Feet below surface

   Pumping level ____ feet below surface after ____ hours pumping

   Drawdown ____ Feet Specific Capacity ____ Gals. per min. per ft. of drawdown

   How pumped ____ How measured ____

   Observed effect on nearby wells ____

9. PERMANENT PUMPING EQUIPMENT:

   Type ____ Mfrs. Name ____

   Capacity ____ G.P.M. How Driven ____ H.P. ____ R.P.M. ____

   Depth of Pump in well ____ Feet Depth of Footpiece in well ____ Feet

   Depth of Air Line in well ____ Feet Type of Meter on Pump ____ Size ____ Inches

10. USED FOR monitoring AMOUNT { Average ____ Gallons Daily, Maximum ____ Gallons Daily }

11. QUALITY OF WATER ____ Sample: Yes ____ No ____

    Taste ____ Odor ____ Color ____ Temp. ____ °F.

12. LOG descriptive Are samples available? yes

    (Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

13. SOURCE OF DATA Woodward-Clyde Consultants

14. DATA OBTAINED BY Woodward-Clyde Consultants Date 22 Apr 81

(NOTE: Use other side of this sheet for additional information such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)

WCC-12m

J. E. FRITTS & ASSOC. INC.

Job No. 29C06103 E

Date 4-22-81

Job Address Old Bridge NJ.

Fixed Datum used is

Ground Surface this boring is

DEPTH From	To	CLASSIFICATION	Sample & Type No.	Sample Depth		No. of 30" blows on Spoon 1st 6"	2nd 6"	3rd 6"	Recovery	Remarks
		12 ~~E~~ 12-M	SS							
Grd Surface	3'	Dk. Gray & Black organic w/ Gray sand layers								1st Shot
			1	5'	6.6	4	20	24		
3'	5'	Br. Damp Silty F/m sand w/ Gravel								
			2	10'	11.6	3	9	11		
6'	8'	Gray F/ sand								
8'	13.6'	Wet Tan F. Br. F/ sand								
			3	15'	16.6	3	13	35		
13.6	18'	Wet Yellow Br. F/ sand F/ silty								
			F	20'	21.6	11	52	50/4"		
18'	27'	Dk. F/m sand w/ gravel wet	A	25'	26.6	8	24	36		
			6	30'	31.6	20	28	40		
27	38'	Gray F/ Silty wet sand	F	35'	36.6	14	29	45		
			6	40'	41.6	21	37	45		
38	43'	Br. F/ wet Silty sand	S-7	45'	46.6	11	24	42		
43'	56.6	Gray F/m wet F/ silty sand	8	50'	51.6	12	19	43		
			F	55	56.6	17	28	47		
		END Boring								

Installed 56.6' of 2" P.V.C. including well screen 10' w/ 1' stick up
Sand Pack 56' up to 42'
Heavy mud pack 42' up to 2'
Cement casing in 2' up to +1
used 2½ bags sand
12 bags mud
1 bag cement

Foreman [signature]

Ground Surface to ______ ft. used ______ casing.

Water level is ______ ft. below Ground surface at completion.

Water level is ______ ft. below Ground surface ______ hrs. after completion.

Boring stopped by ______

Boring No. 12 m

A-242

Form DWR-121
11-80

FOR MONITORING PURPOSES ONLY

STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES

PERMIT NO. 23-12226

APPLICATION NO

COUNTY Middlesex

WELL RECORD

1. OWNER CPS Chemical Company ADDRESS P.O. Box 162, Old Bridge, NJ

Owner's Well No. WCC-13m SURFACE ELEVATION ________ Feet (Above mean sea level)

2. LOCATION

3. DATE COMPLETED 20 Apr 81 DRILLER J.E. Fritts, Co.

4. DIAMETER: Top 10 inches Bottom 10 inches TOTAL DEPTH 55.5 Feet

5. CASING: Type Sch 40 PVC Diameter 2 Inches Length 44 Feet

6. SCREEN: Type Sch 40 PVC Size of Opening 0.020" Diameter 2 Inches Length 10 Feet

Range in Depth { Top 44 Feet, Bottom 54 Feet } Geologic Formation Raritan

Tail Piece: Diameter ________ Inches Length ________ Feet

7. WELL FLOWS NATURALLY ________ Gallons per minute at ________ Feet above surface

Water rises to ________ Feet above surface

8. RECORD OF TEST: Date ________ Yield ________ Gallons per minute

Static water level before pumping ________ Feet below surface

Pumping level ________ feet below surface after ________ hours pumping

Drawdown ________ Feet Specific Capacity ________ Gals. per min. per ft. of drawdown

How pumped ________ How measured ________

Observed effect on nearby wells ________

9. PERMANENT PUMPING EQUIPMENT:

Type ________ Mfrs. Name ________

Capacity ________ G.P.M. How Driven ________ H.P. ________ R.P.M. ________

Depth of Pump in well ________ Feet Depth of Footpiece in well ________ Feet

Depth of Air Line in well ________ Feet Type of Meter on Pump ________ Size ________ Inches

10. USED FOR monitoring AMOUNT { Average ________ Gallons Daily, Maximum ________ Gallons Daily }

11. QUALITY OF WATER ________ Sample: Yes ____ No ____

Taste ________ Odor ________ Color ________ Temp. ________ °F.

12. LOG descriptive Are samples available? yes

(Give details on back of sheet or on separate sheet. If electric log was made, please furnish copy.)

13. SOURCE OF DATA Woodward-Clyde Consultants

14. DATA OBTAINED BY Woodward-Clyde Consultants Date 20 Apr 81

(NOTE: Use other side of this sheet for additional information such as log of materials penetrated, analysis of the water, sketch map, sketch of special casing arrangements, etc.)

WCC-13m

J. E. FRITTS & ASSOC. INC.

Job No 79C04103

Date 4-20-81

Job Address Old Bridge N.J.

Fixed Datum used is

Ground Surface this boring is

From	To	CLASSIFICATION	Sample & Type No.	Sample Depth		No. of 30" blows on Spoon 1st 6"	2nd 6	3rd 6	Recovery	Water Remarks
		13 m								
Grd. Surface	7'	Yellow Br. sand f/m								
1	4'	Gray silt organics								water 4'
		roots wood grass etc.	1	5'	6.6	1	4	6		
4'	13	Br. tan f/m wet	2	10'	11.6	2	5	7		
		sand	3	15'	16.6	2	5	5		
13	18	Gray & Black f/m								
		wet sand & silty	4	20'	21.6	4	9	14		
18	28	Gray f/m wet sand								
		& some gravel	5	25'	26.6	7	6	14		
22	28	Gray f/m wet sand	6	30'	31.6	8	17	28		
28	34	Br. f/m wet sand								
		& some silty	7	35'	36.6	13	15	32		
34	40	Br. f/m wet sand	8	40'	41.6	18	61	50/4		
40'	44'	f/m. f/c wet sand								
		& black streaks	9	45	46.5	15	25	50/6		
44	48	Br. f/m wet sand & silt	10	50'	51.6	16	24	46		
48	53	Gray f/m sand & silty	11	55'	56.6	15	27	50		
53	56.6	Gray stiff clay								
		END Boring								

installed 55' 2" PVC w/ 1' stickup
bottom of screen 54' to 41'
sand pack 55' 41' to 2'
Heavy mud seal 41' to 2' around P.
installed steel casing
in concrete 3' up to +1'

Foreman

Ground Surface to ______ ft. used ______ casing.

Water level is ______ ft. below Ground surface at ______ hrs. after completion.

A-244

Boring No. 13 m

Water level is ______ ft. below Ground surface ______

Boring stopped by ______

DEP

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. Well ST-1
ELEVATION
DATE STARTED 10/20/82
DATE FINISHED 10/20/82

PROJECT CPS-Madison PURPOSE

LOCATION East of Pond WATER LEVEL DATE TIME

TYPE OF DRILLING Hollow stem Auger DRILLER H. Larason HELPER J. Curran INSPECTOR OR GEOLOGIST

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SAMPLE SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
								Threaded 2" P pipe and scre 20 slot No Samples Ta
25								
50								
						20" PVC 20 slot		
75								
0								
5								
0								
5								

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. Well #ST-2
ELEVATION
DATE STARTED 10/20/82
DATE FINISHED 10/20/82

PROJECT CPS-Madison PURPOSE Monitor
LOCATION East of Pond WATER LEVEL DATE TIME

TYPE OF DRILLING Hollow Stem Auger
DRILLER H. Larason
HELPER J. Curran
INSPECTOR OR GEOLOGIST

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. =	REMARKS
0–5								Threaded 2" PV pipe 20 slot P screen. No Samples Tak
5–23						2" PVC Pipe		
23–36						2" PVC Screen 20 slot		

Depth scale: 5, 10, 15, 20, 25, 30, 35

DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF WATER RESOURCES
BUREAU OF GROUND WATER MANAGEMENT

BORING NO. Well #ST-[illegible]
ELEVATION ______
DATE STARTED 10/27/82
DATE FINISHED 10/27/82

PROJECT CPS-Madison PURPOSE ______
LOCATION South of Pond WATER LEVEL ______ DATE ______ TIME ______

TYPE OF DRILLING Hollow Stem Auger DRILLER H. Larason HELPER M. Ryan INSPECTOR OR GEOLOGIST ______

DEPTH	ELEVATION	CASING BLOWS/FOOT	SAMPLE NO.	SAMPLE TYPE	SAMPLE SPOON BLOW 6" PENE.	WELL DESIGN	CLASSIFICATION "0" ELEV. = ______	REMARKS
0–18						2" PVC Pipe		2" PVC Pipe screwed and 10' 20 slot No Samples
5								
10								
15								
20						10ft 2" PVC screen		
25								
30								
5								

A-247

APPENDIX A-7

ANALYTICAL RESULTS (PRIOR TO 1988)

RANGE OF CONSTITUENTS DETECTED IN ALL WELLS (ppb)

	Zinc				Lead				Cadmium			
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
M-1	6340	11/75	625000	9/12/77	2	10/75	555	5/77	11	4/76	1700	9/12/77
M-2	6500	11/75	1660000	10/77	1	9/12/77	948	3/87	28	5/77	2010	3/82
M-3	220	5/83	27250	9/24/75	1	9/12/77	76	10/77	2	+ 10/77	41	4/76
M-4	80	5/83	36250	8/75	1	9/24/75	16	8/76	1	11/75	16	8/75
M-5	100	5/77	4200	8/75	2	9/24/75	24	8/76	2	11/75	12	8/75
M-6	3410	11/88	17000	5/83	5	3/87	14	11/88	15	3/87	130	5/85
S-1	360	10/79	97700	8/77	4	9/12/77	360	10/79	1	9/6/77	10	8/77
S-2	328	8/77	800	9/12/77	9	9/12/77	328	8/77	2	8/77	6	9/12/77
S-3	1225	9/6/77	3100	9/12/77	16	9/12/77	110	10/77	5	9/6/77	9	8/77
A	4830	3/82	515000	5/75	5	3/87	52	10/77	5	3/87	41	9/12/77
B	199	9/6/77	45000	5/83	3	9/24/75	18	3/87	1	& 5/85	11	5/75
C	216	3/82	3250	6/75	3	11/75	117	9/6/77	2	11/75	6	6/75
D	1050	6/75	20050	5/75	8	* 10/77	82	5/75	11	(9/12/77	25	5/75
E	167	9/6/77	7440	5/75	3	9/24/75	18400	4/76	1	8/76	26	5/75
F	217	9/6/77	2600	9/24/75	5	6/75	69	11/75	1	4/76	13	5/75
G	214	9/6/77	3450	11/75	1	9/12/77	15	9/6/77	1	11/75	17	5/75
H	430	11/75	1120	5/75	10	5/77	103	5/75	1	@ 8/76	5	9/24/75
NO.1	1600	6/75	2400	5/75	6	6/75	14	5/75	10	6/75	17	5/75
NO.2	465	10/77	465	10/77								
NO.3	4960	5/75	78750	2/74	3	5/75	41	5/85	2	10/77	31	5/75 a
NO.4	360	5/76	5300	4/76	2	5/76	3	4/76	1	5/76	3	4/76
NO.5	10	4/76	10	4/76	2	6/76	3	4/76	3	6/76	70	4/76
NO.10	962	3/82	8125	5/85	63	5/85	342	3/82	1	5/85	1	5/85
NO.11	1250	3/82	1250	3/82	34	3/82	34	3/82				
NO.12	97000	5/83	156000	3/82	2	4/76	6920	3/82	3	4/76	126	3/82
NO.13												
NO.16	404	3/82	1200	4/76	3	4/76	3	4/76	21	4/76	21	4/76
NO.18												
NO.19	562	3/82	562	3/82	24	3/82	24	3/82				
WCC-1M	428	11/88	586	3/82	13	11/88	30	3/82				
WCC-1D	423	3/82	635	11/88	1.4	11/88	74	3/82	6	3/82	6	3/82
WCC-2	1310	11/88	1310	11/88								
WCC-2M	428	3/82	428	3/82	51	3/82	51	3/82	21	3/82	21	3/82
WCC-3M	424	11/88	447	3/82	40	3/82	40	3/82	9	3/82	9	3/82
WCC-3D	351	3/82	403	11/88	3	11/88	71	3/82				
WCC-4S	950	3/82	950	3/82	30	3/82	30	3/82	8	3/82	8	3/82
WCC-4M	3820	3/82	3820	3/82	203	3/82	203	3/82	7	3/82	7	3/82
WCC-5S	288	3/82	288	3/82								
WCC-6S	486	3/82	820	11/88	1.4	11/88	22	3/82	6	3/82	6	3/82
WCC-6M	259	11/88	1180	3/82	7.8	11/88	74	3/82	34	3/82	34	3/82
WCC-6D	1040	3/82	1040	3/82	206	3/82	206	3/82	12	3/82	12	3/82
WCC-7M	1610	3/82	1610	3/82	30	3/82	30	3/82	19	3/82	19	3/82
WCC-9S	1800	5/83	5415	3/87	5	3/87	71	3/82	5	3/87	6	3/82
WCC-9M	1988	3/87	3900	5/83	5	3/87	5	3/87	5	3/87	5	3/87
WCC-9D	11200	3/82	11200	3/82	40	3/82	40	3/82	22	3/82	22	3/82
WCC-11S	6970	11/88	110000	5/83	2.5	11/88	61	3/82	4	3/82	5	3/87
WCC-11MN	390	5/83	16400	11/88	3.8	11/88	105	3/82	3	3/82	5	3/87
WCC-11DC	998	3/87	5500	3/82	5	3/87	98	3/82	5	3/87	11	3/82
WCC-12M	21	11/88	892	3/82	3.9	11/88	54	3/82	4	3/82	4	3/82
WCC-13	174	11/88	180	5/83	3.2	11/88	71	3/82				
WCC-14S	161	3/82	800	5/83	71	3/82	71	3/82	11	3/82	11	3/82
WCC-15SE	30	5/83	216	3/82	78	3/82	78	3/82	4	3/82	4	3/82
WCC-15M	750	5/83	750	5/83								
WCC-15D	149	3/82	149	3/82	71	3/82	71	3/82	9	3/82	9	3/82
WCC-16S	170	5/83	7100	11/88	2.8	11/88	84	3/82	3	3/82	3	3/82
L-1A					1	4/73	10	3/73				
L-2	25	3/73	25	3/73								
L-3					5	4/73	7	3/73				
L-4	250	4/73	15000	5/73	4	# 2/74	11	3/73	1	3/73	2	5/73

RANGE OF CONSTITUENTS DETECTED IN ALL WELLS (ppb) (Continued)

	Zinc				Lead				Cadmium			
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
L-5	150	4/73	220	2/74					2	3/73	2	3/73
T-1	28540	3/87	289600	5/85	5	3/87	375	5/85	12	5/85	1694	3/87
DEP-1	378	11/88	378	11/88	2	11/88	2	11/88				
DEP-2	354	11/88	354	11/88	1.1	11/88	1.1	11/88				
DEP-4	7660	11/88	7660	11/88	7	11/88	7	11/88	17	11/88	17	11/88
DW-1S	903	11/88	903	11/88								
DW-1D	95	11/88	95	11/88								
DW-2S	659	11/88	659	11/88								
DW-3S	521	11/88	521	11/88								
DW-3D	88	11/88	88	11/88								
DW-4S	1090	11/88	1090	11/88								
DW-4D	207	11/88	207	11/88								
DW-5S	2140	11/88	2140	11/88								
DW-5D	47	11/88	47	11/88								
DW-6S	945	11/88	945	11/88	0.98	11/88	0.98	11/88				
DW-6D	151	11/88	151	11/88	5.5	11/88	5.5	11/88				
DW-7S	108	11/88	108	11/88								
DW-7D	65	11/88	65	11/88								
SAY-PRO A	101	5/85	101	5/85	6	5/85	6	5/85	1	5/85	1	5/85
PA-05												
FB-1	47	11/88	151	3/87	1.2	11/88	25	3/87	5	3/87	5	3/87
FB-2	26	11/88	26	11/88								
FB-3	26	11/88	26	11/88	3.2	11/88	3.2	11/88				
FB-4												
TB-1	51	3/87	51	3/87	43	3/87	43	3/87	5	3/87	5	3/87
TB-2												
TB-3												
TB-4												
MB												

NOTES: When HIGH=LOW, only one sample was taken
"SAY-PRO A" and "PA-05" wells are production wells
Shaded wells represent selected wells
* = Well D also had a low of 8 on 5/75
# = Well L-5 also had a low of 4 on 4/73
+ = Well M-3 also had a low of 2 on 5/77 and 11/75
& = Well B also had a low of 1 on 11/75
@ = Well H also had a low of 1 on 11/75
a = two readings were averaged to obtain this value

Wells	Copper					Methylene cloride				1,1,2,2-tetrachloroethane			
	Low	Date		High	Date	Low	Date	High	Date	Low	Date	High	Date
M-1	870	1983		2800	1982	73	12/78	73	12/78	1.1	12/78	10	10/79
M-2	1689	1987		24000	1988	16	11/88	160	10/79	54	10/79	54	10/79
M-3	120	1983		120	1983	120	4/76	83000	10/79	240	12/78	4510	10/79
M-4	82	1987		82	1987					1.3	12/78	1.3	12/78
M-5	33	1987		33	1987	1.2	12/78	1.2	12/78				
M-6	3200	1983		5682	1987	430	11/88	430	11/88				
S-1						850	9/12/77	67000	10/79	8000	12/78	8430	10/79
S-2													
S-3						2.4	12/78	2.4	12/78				
A	15	1987		60	1983	10	10/79	48.2	10/78	0.7	12/78	13.7	10/78
B	11	1985		15	1987	1400	5/85	391000	10/78	49	5/85	8400	12/78
C	16	1982		16	1982	4.8	7/78	4.8	7/78				
D						0.4	7/78	0.4	7/78	0.4	12/78	0.4	12/78
E						17	10/79	17	10/79	1.6	12/78	1.6	12/78
F													
G													
H													
NO.1						257	10/78	257	10/78	3.3	12/78	3.3	12/78
NO.2													
NO.3	171	1985	a	171	1985	4.6	10/78	42	7/78				
NO.4						1.7	10/78	1.7	10/78				
NO.5						7.2	10/78	7.2	10/78				
NO.10	11	1985		13	1982	1230	10/78	1230	10/78				
NO.11	35	1982		35	1982	2.4	3/82	21330	10/78	1677	10/78	1677	10/78
NO.12	53600	1982		53600	1982	1200	5/85	17000	3/82				
NO.13										94	5/85	94	5/85
NO.16						13	7/78	14	10/78				
NO.18						2.7	10/78	2.7	10/78				
NO.19	21	1982		21	1982								
WCC-1M	48	1982		66	1988					11	3/87	11	3/87
WCC-1D	33	1988		56	1982								
WCC-2													
WCC-2M	33	1988		84	1982								
WCC-3M	30	1988		56	1982								
WCC-3D	33	1988		43	1982								
WCC-4S	64	1982		64	1982								
WCC-4M	157	1982		157	1982								
WCC-5S	25	1982		25	1982								
WCC-6S	65	1988	a	105	1982	3845	3/82	3845	3/82				
WCC-6M	33	1988		256	1982								
WCC-6D	91	1982		91	1982								
WCC-7M	874	1982		874	1982	9.8	3/82	9.8	3/82				
WCC-9S	36	1987		101	1982								
WCC-9M	3672	1987		6900	1983	680	3/87	680	3/87				
WCC-9D	2850	1982		2850	1982	218	3/82	218	3/82				
WCC-11S	15	1987		97	1982								
WCC-11MN													
WCC-11DC	29	1987		172	1982								
WCC-12M	30	1988		91	1982	960	3/87	960	3/87				
WCC-13	8.3	1988		8.3	1988								
WCC-14S	58	1982		58	1982								
WCC-15SE	61	1982		61	1982	34	3/82	18000	5/85	63	5/85	63	5/85
WCC-15M													
WCC-15D	140	1982		140	1982	26.7	3/82	26.7	3/82	20.3	3/82	20.3	3/82
WCC-16S	74	1982		74	1982	7.9	3/82	7.9	3/82	30	3/87	30	3/87
L-1A													
L-2													
L-3													
L-4													

Wells	Copper Low	Date	High	Date	Methylene cloride Low	Date	High	Date	1,1,2,2-tetrachloroethane Low	Date	High	Date
L-5												
T-1	6700	1983	24230	1987	69	5/85	140	3/87	3	5/85	3	5/85
DEP-1	18	1988	18	1988	2	3/87	2	3/87	2	3/87	2	3/87
DEP-2	4.3	1988	4.3	1988	59	3/87	59	3/87				
DEP-4	66	1988	66	1988								
DW-1S												
DW-1D									12	11/88	12	11/88
DW-2S	5.5	1988	5.5	1988								
DW-3S												
DW-3D												
DW-4S	11	1988	11	1988								
DW-4D												
DW-5S												
DW-5D									39	11/88	39	11/88
DW-6S	11	1988	11	1988								
DW-6D	16	1988	16	1988								
DW-7S												
DW-7D									59	11/88	59	11/88
SAY-PRO A	42	1985	42	1985								
PA-05												
FB-1	15	1987	15	1987								
FB-2	5.5	1988	5.5	1988								
FB-3												
FB-4												
TB-1	15	1987	15	1987								
TB-2					26	11/88	26	11/88				
TB-3												
TB-4												
MB					2	3/87	3100	3/82				

	1,2-dichloroethane				1,1-dichloroethane				1,1-dicholorethene				Carbon tetrachloride			
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
M-1	6.5	3/82	6.5	3/82												
M-2	53	3/82	88	11/88												
M-3					13	4/87	13	4/87								
M-4																
M-5																
M-6	670	11/88	670	11/88												
S-1																
S-2																
S-3																
A	6.8	3/82	6.8	3/82	640	4/87	640	4/87					9.2	3/82	9.2	3/82
B	16	4/87	210	5/85	14	5/85	14	5/85	3	5/85	3	5/85	6.5	5/85	6.5	5/85
C																
D																
E																
F																
G																
H																
NO.1																
NO.2																
NO.3	15	5/85	15	5/85												
NO.4																
NO.5																
NO.10																
NO.11	12.3	3/82	12.3	3/82												
NO.12	770	5/85	4200	3/82	2	5/85	117	3/82	3	5/85	3	5/85	1750	3/82	1750	3/82
NO.13																
NO.16													15	3/82	15	3/82
NO.18																
NO.19																
WCC-1M	68	11/88	140	4/87												
WCC-1D	16	3/82	16	3/82									15	3/82	15	3/82
WCC-2																
WCC-2M																
WCC-3M	5.8	3/82	5.8	3/82												
WCC-3D																
WCC-4S																
WCC-4M																
WCC-5S																
WCC-6S	54	3/82	440	3/82	10.2	3/82	206	3/82					69	3/82	4480	3/82
WCC-6M																
WCC-6D	28	11/88	28	11/88									104	3/82	104	3/82
WCC-7M					16.9	3/82	16.9	3/82					17.3	3/82	17.3	3/82
WCC-9S	17	4/87	17	4/87												
WCC-9M	1200	4/87	1200	4/87												
WCC-9D	69	3/82	69	3/82												
WCC-11S	12	4/87	15.8	3/82									25.5	3/82	25.5	3/82
WCC-11MN	22.6	3/82	28	11/88									11.1	3/82	11.1	3/82
WCC-11DC	8	3/82	8	3/82												
WCC-12M	80	11/88	1200	4/87												
WCC-13																
WCC-14S																
WCC-15SE	106	3/82	2000	5/85	1.7	3/82	22	5/85	6	5/85	6	5/85	49	3/82	49	3/82
WCC-15M	120	4/87	120	4/87												
WCC-15D	24.4	3/82	24.4	3/82	4.5	3/82	4.5	3/82					60	3/82	60	3/82
WCC-16S																
L-1A																
L-2																
L-3																
L-4																

	1,2-dichloroethane				1,1-dichloroethane				1,1-dicholorethene				Carbon tetrachloride			
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
L-5																
T-1	208	5/85	208	5/85	400	4/87	400	4/87								
DEP-1	22	4/87	22	4/87												
DEP-2																
DEP-4																
DW-1S																
DW-1D	24	11/88	24	11/88												
DW-2S																
DW-3S																
DW-3D																
DW-4S																
DW-4D																
DW-5S																
DW-5D	13	11/88	13	11/88												
DW-6S																
DW-6D																
DW-7S																
DW-7D																
SAY-PRO A																
PA-05																
FB-1																
FB-2																
FB-3																
FB-4																
TB-1																
TB-2																
TB-3																
TB-4																
MB																

	Bromoform				Benzene				Toluene			
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
M-1												
M-2					4.2	3/82	4.2	3/82	5.7	3/82	5.7	3/82
M-3					22	4/87	22	4/87	6	4/87	6	4/87
M-4												
M-5												
M-6												
S-1												
S-2												
S-3												
A	18	3/82	18	3/82	4.5	3/82	4.5	3/82	9.8	3/82	9.8	3/82
B					60	4/87	60	4/87	29	4/87	29	4/87
C									6	4/87	6	4/87
D												
E												
F												
G												
H												
NO.1												
NO.2												
NO.3									18	5/85	19	5/85
NO.4												
NO.5												
NO.10												
NO.11	11	3/82	11	3/82	3.8	3/82	3.8	3/82	2.5	3/82	2.5	3/82
NO.12	2600	3/82	2600	3/82	655	3/82	655	3/82	2130	3/82	2130	3/82
NO.13												
NO.16												
NO.18												
NO.19												
WCC-1M												
WCC-1D												
WCC-2												
WCC-2M												
WCC-3M									2	3/82	2	3/82
WCC-3D												
WCC-4S												
WCC-4M												
WCC-5S					194	3/82	194	3/82	68	3/82	68	3/82
WCC-6S	205	3/82	205	3/82	60	3/82	125	3/82	314	3/82	795	3/82
WCC-6M					7	4/87	7	4/87				
WCC-6D					8.2	3/82	8.2	3/82				
WCC-7M									124	3/82	124	3/82
WCC-9S												
WCC-9M												
WCC-9D												
WCC-11S	32	3/82	32	3/82	7.6	3/82	94	4/87	5.8	3/82	7	4/87
WCC-11MN	131	3/82	131	3/82	3.3	3/82	3.3	3/82	9.1	3/82	9.1	3/82
WCC-11DC					1.1	3/82	1.1	3/82				
WCC-12M					120	11/88	320	4/87	290	11/88	3000	4/87
WCC-13												
WCC-14S												
WCC-15SE	97	3/82	97	3/82	20.3	3/82	190	4/87	42	3/82	700	4/87
WCC-15M									5	4/87	5	4/87
WCC-15D	73	3/82	73	3/82	15.1	3/82	15.1	3/82	45	3/82	45	3/82
WCC-16S												
L-1A												
L-2												
L-3												
L-4												

	Bromoform				Benzene				Toluene			
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
L-5												
T-1					3	5/85	3	5/85				
DEP-1					0.6	3/82	0.6	3/82	1	4/87	1	4/87
DEP-2					230	4/87	310	11/88	850	4/87	980	11/88
DEP-4												
DW-1S												
DW-1D												
DW-2S												
DW-3S												
DW-3D												
DW-4S												
DW-4D												
DW-5S					79	11/88	79	11/88	63	11/88	63	11/88
DW-5D												
DW-6S												
DW-6D												
DW-7S					62	11/88	62	11/88				
DW-7D									22	11/88	22	11/88
SAY-PRO A									11	5/85	11	5/85
PA-05									7	4/87	7	4/87
FB-1												
FB-2												
FB-3												
FB-4												
TB-1												
TB-2												
TB-3									1	4/87	1	4/87
TB-4												
MB									6	4/87	6	4/87

	Bis(2-ethylhexyl)phthalate				1,2-dichloropropane				Chlorobenzene			
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
M-1												
M-2												
M-3									17	4/87	17	4/87
M-4												
M-5												
M-6												
S-1												
S-2												
S-3												
A					2.2	3/82	2.2	3/82				
B					3.8	5/85	3.8	5/85	110	4/87	300	5/85
C												
D												
E												
F												
G												
H												
NO.1												
NO.2												
NO.3												
NO.4												
NO.5												
NO.10												
NO.11					2.9	3/82	2.9	3/82				
NO.12					10	5/85	375	3/82	26.9	3/82	300	5/85
NO.13												
NO.16												
NO.18												
NO.19	32	3/82	32	3/82								
WCC-1M	22	3/82	22	3/82	6	3/82	6	3/82				
WCC-1D	36	3/82	36	3/82								
WCC-2												
WCC-2M	43	3/82	43	3/82								
WCC-3M												
WCC-3D												
WCC-4S												
WCC-4M	43	3/82	43	3/82								
WCC-5S					129	3/82	129	3/82				
WCC-6S	42	3/82	42	3/82	101	3/82	122	3/82	32	3/82	115	3/82
WCC-6M					3.2	3/82	3.2	3/82				
WCC-6D	27	3/82	27	3/82								
WCC-7M	37	3/82	37	3/82	34	3/82	34	3/82	3.8	3/82	3.8	3/82
WCC-9S												
WCC-9M												
WCC-9D	24	3/82	24	3/82								
WCC-11S	175	3/82	175	3/82	4.2	3/82	4.2	3/82	4.5	3/82	65	4/87
WCC-11MN												
WCC-11DC												
WCC-12M									900	4/87	1100	11/88
WCC-13												
WCC-14S												
WCC-15SE					11.6	3/82	24	5/85	100	5/85	580	4/87
WCC-15M												
WCC-15D					17.2	3/82	17.2	3/82	3.9	3/82	3.9	3/82
WCC-16S												
L-1A												
L-2												
L-3												
L-4												

	Bis(2-ethylhexyl)phthalate				1,2-dichloropropane				Chlorobenzene			
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
L-5												
T-1												
DEP-1												
DEP-2									290	4/87	460	11/88
DEP-4												
DW-1S									22	11/88	22	11/88
DW-1D												
DW-2S												
DW-3S												
DW-3D												
DW-4S												
DW-4D												
DW-5S									290	11/88	290	11/88
DW-5D									59	11/88	59	11/88
DW-6S												
DW-6D												
DW-7S												
DW-7D									580	11/88	580	11/88
SAY-PRO A												
PA-05												
FB-1												
FB-2												
FB-3												
FB-4												
TB-1												
TB-2												
TB-3												
TB-4												
MB	60	3/82	60	3/82								

Wells	Trans-1,2-dichloroethylene				Ethylbenzene				Total xylenes				1,1,1-trichloroethane			
	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
M-1													2.6	3/82	2.6	3/82
M-2					17	3/82	17	3/82	10	3/82	10	3/82	3.7	3/82	3.7	3/82
M-3	30	4/87	30	4/87												
M-4																
M-5																
M-6																
S-1																
S-2																
S-3																
A	26.4	3/82	26.4	3/82	3.9	3/82	3.9	3/82	9.4	3/82	9.4	3/82				
B	110	4/87	110	4/87	22	4/87	22	4/87								
C																
D																
E																
F																
G																
H																
NO.1																
NO.2																
NO.3																
NO.4																
NO.5																
NO.10																
NO.11	12	3/82	12	3/82	5.3	3/82	5.3	3/82								
NO.12	925	3/82	925	3/82	330	3/82	330	3/82	1190	3/82	1190	3/82	38	3/82	38	3/82
NO.13																
NO.16																
NO.18																
NO.19																
WCC-1M	32	4/87	32	4/87												
WCC-1D																
WCC-2																
WCC-2M																
WCC-3M																
WCC-3D																
WCC-4S																
WCC-4M																
WCC-5S	81	3/82	81	3/82												
WCC-6S	26.3	3/82	185	3/82	60	3/82	82	3/82	116	3/82	185	3/82	56	3/82	2200	3/82
WCC-6M	4.9	3/82	4.9	3/82												
WCC-6D																
WCC-7M	3.1	3/82	3.1	3/82	5.4	3/82	5.4	3/82	7.2	3/82	7.2	3/82				
WCC-9S																
WCC-9M																
WCC-9D													2.7	3/82	2.7	3/82
WCC-11S	24	4/87	31	3/82	6.4	3/82	16	4/87	6.8	3/82	6.8	3/82				
WCC-11MN	23	3/82	23	3/82	6	3/82	6	3/82	9.3	3/82	9.3	3/82				
WCC-11DC	2.5	3/82	2.5	3/82												
WCC-12M	1600	4/87	1600	4/87	50	11/88	50	11/88								
WCC-13																
WCC-14S																
WCC-15SE	131	3/82	131	3/82	14.1	3/82	68	4/87	42	3/82	42	3/82				
WCC-15M																
WCC-15D	41	3/82	41	3/82	12.4	3/82	12.4	3/82	30	3/82	30	3/82				
WCC-16S																
L-1A																
L-2																
L-3																
L-4																

Wells	Trans-1,2-dichloroethylene				Ethylbenzene				Total xylenes				1,1,1-trichloroethane			
	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
L-5																
T-1																
DEP-1	4	4/87	4	4/87												
DEP-2	46	4/87	46	4/87	72	4/87	87	11/88								
DEP-4																
DW-1S																
DW-1D																
DW-2S																
DW-3S																
DW-3D																
DW-4S																
DW-4D																
DW-5S					26	11/88	26	11/88								
DW-5D					10	11/88	10	11/88								
DW-6S													12	11/88	12	11/88
DW-6D													12	11/88	12	11/88
DW-7S					40	11/88	40	11/88								
DW-7D																
SAY-PRO A																
PA-05																
FB-1																
FB-2																
FB-3																
FB-4																
TB-1																
TB-2																
TB-3													0.9	4/87	0.9	4/87
TB-4																
MB																

Wells	Trichloroethylene Low	Date	High	Date	Crysene Low	Date	High	Date	1,3-dichlorobenzene Low	Date	High	Date	1,4-dichlorobenzene Low	Date	High	Date
M-1					24	3/82	24	3/82								
M-2	14	11/88	20.3	3/82												
M-3	7	4/87	7	4/87												
M-4																
M-5																
M-6	80	11/88	80	11/88												
S-1																
S-2																
S-3																
A	72	4/87	72	4/87												
B																
C																
D																
E																
F																
G																
H																
NO.1																
NO.2																
NO.3																
NO.4																
NO.5																
NO.10																
NO.11	2.3	3/82	2.3	3/82												
NO.12	1230	3/82	1230	3/82												
NO.13																
NO.16																
NO.18																
NO.19																
WCC-1M	19	11/88	38	3/82												
WCC-1D																
WCC-2																
WCC-2M																
WCC-3M																
WCC-3D																
WCC-4S																
WCC-4M																
WCC-5S																
WCC-6S	524	3/82	524	3/82	24	3/82	24	3/82	21	3/82	21	3/82	21	3/82	21	3/82
WCC-6M																
WCC-6D	17	4/87	17	4/87												
WCC-7M																
WCC-9S																
WCC-9M	190	4/87	190	4/87												
WCC-9D	5.3	3/82	5.3	3/82												
WCC-11S																
WCC-11MN	12.9	3/82	12.9	3/82												
WCC-11DC																
WCC-12M																
WCC-13																
WCC-14S																
WCC-15SE																
WCC-15M	17	4/87	17	4/87												
WCC-15D																
WCC-16S																
L-1A																
L-2																
L-3																
L-4																

Wells	Trichloroethylene Low	Date	High	Date	Crysene Low	Date	High	Date	1,3-dichlorobenzene Low	Date	High	Date	1,4-dichlorobenzene Low	Date	High	Date
L-5																
T-1	47	4/87	47	4/87												
DEP-1	6	4/87	6	4/87												
DEP-2																
DEP-4																
DW-1S																
DW-1D	10	11/88	10	11/88												
DW-2S																
DW-3S																
DW-3D																
DW-4S																
DW-4D																
DW-5S																
DW-5D	38	11/88	38	11/88												
DW-6S																
DW-6D																
DW-7S	59	11/88	59	11/88												
DW-7D																
SAY-PRO A																
PA-05																
FB-1																
FB-2																
FB-3																
FB-4																
TB-1																
TB-2																
TB-3																
TB-4																
MB																

Wells	Hexachlorobenzene Low	Date	High	Date	Hexachlorobutadiene Low	Date	High	Date	n-Nitrodiphenylamine Low	Date	High	Date	Benzidene Low	Date	High	Date	Dimethylphthalate Low	Date	High	Date
M-1																				
M-2																				
M-3																				
M-4																				
M-5																				
M-6																				
S-1																				
S-2																				
S-3																				
A																				
B																				
C																				
D																				
E																				
F																				
G																				
H																				
NO.1																				
NO.2																				
NO.3																				
NO.4																				
NO.5																				
NO.10																				
NO.11																				
NO.12					182	3/82	182	3/82	208	3/82	208	3/82								
NO.13																				
NO.16																				
NO.18																				
NO.19																				
WCC-1M																				
WCC-1D																				
WCC-2																				
WCC-2M																				
WCC-3M																				
WCC-3D																				
WCC-4S																				
WCC-4M																				
WCC-5S																				
WCC-6S	53	3/82	53	3/82	73	3/82	73	3/82	24	3/82	471	3/82					26	3/82	26	3/82
WCC-6M																				
WCC-6D																				
WCC-7M																				
WCC-9S																				
WCC-9M																				
WCC-9D													34	3/82	34	3/82				
WCC-11S																	93	3/82	93	3/82
WCC-11MN																				
WCC-11DC																				
WCC-12M																				
WCC-13																				
WCC-14S																				
WCC-15SE																				
WCC-15M																				
WCC-15D																				
WCC-16S																				
L-1A																				
L-2																				
L-3																				
L-4																				

	Hexachlorobenzene				Hexachlorobutadiene				n-Nitrodiphenylamine				Benzidene				Dimethylphthalate			
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
L-5																				
T-1																				
DEP-1																				
DEP-2																				
DEP-4																				
DW-1S																				
DW-1D																				
DW-2S																				
DW-3S																				
DW-3D																				
DW-4S																				
DW-4D																				
DW-5S																				
DW-5D																				
DW-6S																				
DW-6D																				
DW-7S																				
DW-7D																				
SAY-PRO A																				
PA-05																				
FB-1																				
FB-2																				
FB-3																				
FB-4																				
TB-1																				
TB-2																				
TB-3																				
TB-4																				
MB																				

	bis(2-chloroethoxy) methane				Naphthalene				Nitrobenzene				n-Nitrosodi-n-propylamine				2-chloronaphthalene			
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
M-1																				
M-2																				
M-3																				
M-4																				
M-5																				
M-6																				
S-1																				
S-2																				
S-3																				
A																				
B																				
C																				
D																				
E																				
F																				
G																				
H																				
NO.1																				
NO.2																				
NO.3																				
NO.4																				
NO.5																				
NO.10																				
NO.11																				
NO.12	41	3/82	41	3/82	41	3/82	41	3/82	182	3/82	182	3/82	182	3/82	182	3/82	102	3/82	102	3/8
NO.13																				
NO.16																				
NO.18																				
NO.19																				
WCC-1M																				
WCC-1D																				
WCC-2																				
WCC-2M																				
WCC-3M																				
WCC-3D																				
WCC-4S																				
WCC-4M																				
WCC-5S																				
WCC-6S																				
WCC-6M																				
WCC-6D																				
WCC-7M																				
WCC-9S																				
WCC-9M																				
WCC-9D																				
WCC-11S																				
WCC-11MN																				
WCC-11DC																				
WCC-12M																				
WCC-13																				
WCC-14S																				
WCC-15SE																				
WCC-15M																				
WCC-15D																				
WCC-16S																				
L-1A																				
L-2																				
L-3																				
L-4																				

Wells	bis(2-chloroethoxy) methane				Naphthalene				Nitrobenzene				n-Nitrosodi-n-propylamine				2-chloronaphthalene			
	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
L-5																				
T-1																				
DEP-1																				
DEP-2																				
DEP-4																				
DW-1S																				
DW-1D																				
DW-2S																				
DW-3S																				
DW-3D																				
DW-4S																				
DW-4D																				
DW-5S																				
DW-5D																				
DW-6S																				
DW-6D																				
DW-7S																				
DW-7D																				
SAY-PRO A																				
PA-05																				
FB-1																				
FB-2																				
FB-3																				
FB-4																				
TB-1																				
TB-2																				
TB-3																				
TB-4																				
MB																				

Wells	Chloroform				Acenaphthene				Acenaphthylene				Hexachlorocyclo-pentadiene				Vinyl cloride			
	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
M-1																				
M-2																				
M-3																				
M-4																				
M-5																				
M-6																				
S-1																				
S-2																				
S-3																				
A																				
B																	7	4/87	7	4/87
C																				
D																				
E																				
F																				
G																				
H																				
NO.1																				
NO.2																				
NO.3	1	5/85	1	5/85																
NO.4																				
NO.5																				
NO.10																				
NO.11																				
NO.12													125	3/82	125	3/82				
NO.13																				
NO.16																				
NO.18																				
NO.19																				
WCC-1M																				
WCC-1D																				
WCC-2																				
WCC-2M																				
WCC-3M																				
WCC-3D																				
WCC-4S																				
WCC-4M																				
WCC-5S																				
WCC-6S	1070	3/82	1070	3/82	23	3/82	23	3/82	46	3/82	46	3/82	184	3/82	184	3/82				
WCC-6M																				
WCC-6D																				
WCC-7M																				
WCC-9S																				
WCC-9M																				
WCC-9D																				
WCC-11S																	7	4/87	7	4/87
WCC-11MN																				
WCC-11DC																				
WCC-12M																				
WCC-13																				
WCC-14S																				
WCC-15SE																				
WCC-15M																				
WCC-15D																				
WCC-16S																				
L-1A																				
L-2																				
L-3																				
L-4																				

Wells	Chloroform				Acenaphthene				Acenaphthylene				Hexachlorocyclo-pentadiene				Vinyl cloride			
	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
L-5																				
T-1	2	5/85	2	5/85																
DEP-1	4	4/87	4	4/87																
DEP-2	200	4/87	200	4/87																
DEP-4																				
DW-1S																				
DW-1D																				
DW-2S																				
DW-3S																				
DW-3D																				
DW-4S																				
DW-4D																				
DW-5S																				
DW-5D																				
DW-6S																				
DW-6D																				
DW-7S																	11	1/88	11	1/88
DW-7D																				
SAY-PRO A																				
PA-05																				
FB-1																				
FB-2																				
FB-3	16	4/87	16	4/87																
FB-4																				
TB-1	31	4/87	31	4/87																
TB-2																				
TB-3	6	4/87	6	4/87																
TB-4																				
MB																				

	Chloromethane				Trichlorofluoromethane				1,2-dichloroethane (total)				Tetrachloroethene			
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
M-1																
M-2																
M-3																
M-4																
M-5																
M-6																
S-1																
S-2																
S-3																
A																
B									220	5/85	220	5/85				
C					2	4/87	2	4/87								
D																
E																
F																
G																
H																
NO.1																
NO.2																
NO.3																
NO.4																
NO.5																
NO.10																
NO.11																
NO.12									500	5/85	500	5/85				
NO.13																
NO.16																
NO.18																
NO.19																
WCC-1M																
WCC-1D																
WCC-2																
WCC-2M																
WCC-3M																
WCC-3D																
WCC-4S																
WCC-4M																
WCC-5S																
WCC-6S																
WCC-6M																
WCC-6D																
WCC-7M																
WCC-9S																
WCC-9M																
WCC-9D																
WCC-11S																
WCC-11MN																
WCC-11DC																
WCC-12M									400	11/88	400	11/88				
WCC-13																
WCC-14S																
WCC-15SE									1600	5/85	1600	5/85				
WCC-15M	9	4/87	9	4/87												
WCC-15D																
WCC-16S																
L-1A																
L-2																
L-3																
L-4																

	Chloromethane				Trichlorofluoromethane				1,2-dichloroethane (total)				Tetrachloroethene			
Wells	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date	Low	Date	High	Date
L-5																
T-1																
DEP-1																
DEP-2									48	11/88	48	11/88				
DEP-4																
DW-1S																
DW-1D									10	11/88	10	11/88				
DW-2S																
DW-3S																
DW-3D																
DW-4S																
DW-4D																
DW-5S																
DW-5D									34	11/88	34	11/88	18	11/88	18	11/88
DW-6S																
DW-6D																
DW-7S									56	11/88	56	11/88	24	11/88	24	11/88
DW-7D																
SAY-PRO A																
PA-05					3	4/87	3	4/87								
FB-1																
FB-2																
FB-3																
FB-4																
TB-1																
TB-2																
TB-3																
TB-4																
MB					2	4/87	2	4/87								

Wells	Trichloroethene				1,3-dichloropropene			
	Low	Date	High	Date	Low	Date	High	Date
M-1								
M-2								
M-3								
M-4								
M-5								
M-6								
S-1								
S-2								
S-3								
A								
B	48	5/85	48	5/85	6	5/85	6	5/85
C								
D								
E								
F								
G								
H								
NO.1								
NO.2								
NO.3								
NO.4								
NO.5								
NO.10								
NO.11								
NO.12	120	5/85	120	5/85				
NO.13								
NO.16								
NO.18								
NO.19								
WCC-1M								
WCC-1D								
WCC-2								
WCC-2M								
WCC-3M								
WCC-3D								
WCC-4S								
WCC-4M								
WCC-5S								
WCC-6S								
WCC-6M								
WCC-6D								
WCC-7M								
WCC-9S								
WCC-9M								
WCC-9D								
WCC-11S								
WCC-11MN								
WCC-11DC								
WCC-12M								
WCC-13								
WCC-14S								
WCC-15SE	340	5/85	340	5/85				
WCC-15M								
WCC-15D								
WCC-16S								
L-1A								
L-2								
L-3								
L-4								

Wells	Trichloroethene Low	Date	High	Date	1,3-dichloropropene Low	Date	High	Date
L-5								
T-1	33	5/85	33	5/85				
DEP-1								
DEP-2								
DEP-4								
DW-1S								
DW-1D								
DW-2S								
DW-3S								
DW-3D								
DW-4S								
DW-4D								
DW-5S								
DW-5D								
DW-6S								
DW-6D								
DW-7S								
DW-7D								
SAY-PRO A								
PA-05								
FB-1								
FB-2								
FB-3								
FB-4								
TB-1								
TB-2								
TB-3								
TB-4								
MB								

APPENDIX A-8

COMPLETE ANALYTICAL RESULTS OF 1990 SAMPLES

APPENDIX A-8. COMPLETE ANALYTICAL RESULTS OF 1990 SAMPLES

Parameter / Collection Date	Units	Method Detection Limit	CPS-DW-5D 3/21/90	CPS-DW-5S 3/21/90	CPS-WCC-5S 3/21/90	CPS-WCC-6M 3/21/90	CPS-WCC-6S 3/21/90	CPS-DW-7D 3/21/90	CPS-DW-7S 3/21/90	CPS-DW-8D 3/21/90	CPS-DW-8S 3/21/90	CPS-WCC-11M 3/21/90	CPS-DW-12 3/21/90
VOLATILE ORGANIC COMPOUNDS													
Chloromethane	µg/L	10	10	10	10	10	10	10	10	10	10	10	10
Bromomethane	µg/L	10	10	10	10	10	10	10	10	10	10	10	10
Vinyl Chloride	µg/L	10	10	10	10	10	10	10	10	10	10	10	10
Chloroethane	µg/L	10	10	10	10	10	10	10	10	10	10	10	10
Methylene Chloride	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Trichlorofluoromethane	µg/L	10	10	10	10	10	10	10	10	10	10	10	10
Acrolein	µg/L	100	100	100	100	100	100	100	100	100	100	100	100
Acrylonitrile	µg/L	35	35	35	35	35	35	35	35	35	35	35	35
1,1-Dichloroethene	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
1,1-Dichloroethane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
1,2-Dichloroethene (total)	µg/L	5	5	5	5	4	5	5	5	5	5	5	5
Chloroform	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
1,2-Dichloroethane	µg/L	5	5	5	5	5	5	3	5	5	5	5	5
1,1,1-Trichloroethane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Carbon Tetrachloride	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Bromodichloromethane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
2-Chloroethylvinylether	µg/L	10	10	10	10	10	10	10	10	10	10	10	10
1,2-Dichloropropane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
cis-1,3-Dichloropropene	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Trichloroethene	µg/L	5	5	5	5	6	5	5	5	5	5	5	5
Benzene	µg/L	5	5	3	5	5	5	5	5	5	5	5	5
trans-1,3-Dichloropropene	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Dibromochloromethane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
1,1,2-Trichloroethane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Bromoform	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Tetrachloroethene	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
1,1,2,2-Tetrachloroethane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Toluene	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Chlorobenzene	µg/L	5	5	13	5	5	5	35	5	5	5	5	5
Ethylbenzene	µg/L	5	5	5	5	5	5	7	5	5	5	5	5
METALS													
Cadmium	µg/L	10	10	10	10	21.2	10	10	10	10	10	29.8	10
Copper	µg/L	25	36.5	25	128	494	25	25	25	36	25	25.7	47.9
Lead	µg/L	3	7.8	3	24.6	100	51	3	3	11.1	5.5	3	13.4
Zinc	µg/L	20	415	26600	1220	3830	320	106	120	7760	1350	26400	4180

APPENDIX A-8. COMPLETE ANALYTICAL RESULTS OF 1990 SAMPLES

Parameter / Collection Date	Units	Method Detection Limit	CPS-WCC-1M 3/20/90	CPS-MI-02 3/20/90	CPS-MW-3D 3/20/90	CPS-MW-3S 3/20/90	CPS-MW-4S 3/20/90	CPS-MW-4D 3/20/90	CPS-FB-01 3/20/90	CPS-TB-01 3/20/90	CPS-DW-1S 3/21/90	CPS-DW-1D 3/21/90	CPS-DEP-2 3/21/90
VOLATILE ORGANIC COMPOUNDS													
Chloromethane	µg/L	10	10	10	10	10	10	10	10	10	10	10	10
Bromomethane	µg/L	10	10	10	10	10	10	10	10	10	10	10	10
Vinyl Chloride	µg/L	10	10	10	10	10	10	10	10	10	10	10	10
Chloroethane	µg/L	10	10	10	10	10	10	10	10	10	10	10	10
Methylene Chloride	µg/L	5	5	5	5	5	5	5	7	5	5	71	5
Trichlorofluoromethane	µg/L	10	10	10	10	10	10	10	10	10	10	10	10
Acrolein	µg/L	100	100	100	100	100	100	100	100	100	100	100	100
Acrylonitrile	µg/L	35	35	35	35	35	35	35	35	35	35	35	35
1,1-Dichloroethene	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
1,1-Dichloroethane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
1,2-Dichloroethene (total)	µg/L	5	8	5	5	5	5	5	5	5	5	5	5
Chloroform	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
1,2-Dichloroethane	µg/L	5	20	5	5	5	5	5	5	5	5	14	5
1,1,1-Trichloroethane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Carbon Tetrachloride	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Bromodichloromethane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
2-Chloroethylvinylether	µg/L	10	10	10	10	10	10	10	10	10	10	10	10
1,2-Dichloropropane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
cis-1,3-Dichloropropene	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Trichloroethene	µg/L	5	11	5	5	5	5	5	5	5	5	5	5
Benzene	µg/L	5	5	5	5	5	5	5	5	5	63	6	61
trans-1,3-Dichloropropene	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Dibromochloromethane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
1,1,2-Trichloroethane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Bromoform	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Tetrachloroethene	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
1,1,2,2-Tetrachloroethane	µg/L	5	5	5	5	5	5	5	5	5	5	5	5
Toluene	µg/L	5	5	5	5	5	5	5	5	5	5	8	5
Chlorobenzene	µg/L	5	5	5	5	5	5	5	5	5	340	47	91
Ethylbenzene	µg/L	5	5	5	5	5	5	5	5	5	10	5	16
METALS													
Cadmium	µg/L	10	10	11300	10	10	10	10	10	NA	10	10	10
Copper	µg/L	25	25	9800	25	25	25	25	33	NA	25	66.9	25
Lead	µg/L	3	6.5	1668	3	3	3	3	3	NA	3	15.3	3
Zinc	µg/L	20	638	1900000	752	562	403	530	393	NA	470	391	30.9

APPENDIX A-8. COMPLETE ANALYTICAL RESULTS OF 1990 SAMPLES

Parameter / Collection Date	Units	Method Detection Limit	CPS-WCC-12 3/21/90	CPS-WCC-13 3/21/90	CPS-WCC-15M 3/21/90	CPS-WCC-16VS 3/21/90	CPS-FB-02 3/21/90	CPS-TB-02 3/21/90	CPS-MI-T1 3/22/90	CPS-DEP-4 3/22/90	CPS-MI-07 3/22/90	CPS-DW-9D 3/22/90
VOLATILE ORGANIC COMPOUNDS												
Chloromethane	µg/L	10	10	10	10	10	10	10	10	10	10	10
Bromomethane	µg/L	10	10	10	10	10	10	10	10	10	10	10
Vinyl Chloride	µg/L	10	19	10	10	10	10	10	10	10	10	10
Chloroethane	µg/L	10	10	10	10	10	10	10	10	10	10	10
Methylene Chloride	µg/L	5	5	5	5	5	5	5	5	5	5	5
Trichlorofluoromethane	µg/L	10	10	10	10	10	10	10	10	10	10	10
Acrolein	µg/L	100	100	100	100	100	100	100	100	100	100	100
Acrylonitrile	µg/L	35	35	35	35	35	35	35	35	35	35	35
1,1-Dichloroethene	µg/L	5	5	5	5	5	5	5	5	5	5	5
1,1-Dichloroethane	µg/L	5	5	5	5	5	5	5	5	5	5	5
1,2-Dichloroethene (total)	µg/L	5	91	5	5	5	5	5	5	5	5	5
Chloroform	µg/L	5	5	5	5	5	5	5	5	5	5	5
1,2-Dichloroethane	µg/L	5	11	5	9	5	5	5	57	5	5	5
1,1,1-Trichloroethane	µg/L	5	5	5	5	5	5	5	5	5	5	5
Carbon Tetrachloride	µg/L	5	5	5	5	5	5	5	5	5	5	5
Bromodichloromethane	µg/L	5	5	5	5	5	5	5	5	5	5	5
2-Chloroethylvinylether	µg/L	10	10	10	10	10	10	10	10	10	10	10
1,2-Dichloropropane	µg/L	5	5	5	5	5	5	5	5	5	5	5
cis-1,3-Dichloropropene	µg/L	5	5	5	5	5	5	5	5	5	5	5
Trichloroethene	µg/L	5	5	5	5	5	5	5	8	5	5	5
Benzene	µg/L	5	40	5	5	91	5	5	5	5	5	5
trans-1,3-Dichloropropene	µg/L	5	5	5	5	5	5	5	5	5	5	5
Dibromochloromethane	µg/L	5	5	5	5	5	5	5	5	5	5	5
1,1,2-Trichloroethane	µg/L	5	5	5	5	5	5	5	5	5	5	5
Bromoform	µg/L	5	5	5	5	5	5	5	5	5	5	5
Tetrachloroethene	µg/L	5	5	5	5	5	5	5	5	5	5	5
1,1,2,2-Tetrachloroethane	µg/L	5	5	5	6	5	5	5	5	5	5	5
Toluene	µg/L	5	97	5	5	8	5	5	5	5	5	5
Chlorobenzene	µg/L	5	790	5	5	560	5	5	5	5	5	5
Ethylbenzene	µg/L	5	16	5	5	27	5	5	5	5	5	5
METALS												
Cadmium	µg/L	10	10	10	10	10	10		207	10	10	10
Copper	µg/L	25	25	25	89.4	25	25	NA	217	25	25	25
Lead	µg/L	3	6.6	6.4	15.3	3	3	NA	39.2	3	3	3
Zinc	µg/L	20	42.5	190	5800	346	20	NA	9510	2330	7840	154

APPENDIX A-8. COMPLETE ANALYTICAL RESULTS OF 1990 SAMPLES

Parameter / Collection Date	Units	Method Detection Limit	CPS-DW-9S 3/22/90	CPS-DW-10D 3/22/90	CPS-DW-13D 3/22/90	CPS-DW-13S 3/22/90	CPS-DW-14 3/22/90	CPS-FB-03 3/22/90	CPS-TB-03 3/22/90	PA-A-014
VOLATILE ORGANIC COMPOUNDS										
Chloromethane	µg/L	10	10	10	10	10	10	10	10	10
Bromomethane	µg/L	10	10	10	10	10	10	10	10	10
Vinyl Chloride	µg/L	10	10	10	10	10	10	10	10	10
Chloroethane	µg/L	10	10	10	10	10	10	10	10	10
Methylene Chloride	µg/L	5	5	5	5	5	5	92	5	5
Trichlorofluoromethane	µg/L	10	10	10	10	10	10	10	10	10
Acrolein	µg/L	100	100	100	100	100	100	100	100	100
Acrylonitrile	µg/L	35	35	35	35	35	35	35	35	35
1,1-Dichloroethene	µg/L	5	5	5	5	5	5	5	5	5
1,1-Dichloroethane	µg/L	5	5	5	5	5	5	5	5	5
1,2-Dichloroethene (total)	µg/L	5	5	5	5	5	5	5	5	5
Chloroform	µg/L	5	5	5	5	5	5	5	5	5
1,2-Dichloroethane	µg/L	5	5	5	5	5	5	5	5	200
1,1,1-Trichloroethane	µg/L	5	5	5	5	5	5	5	5	5
Carbon Tetrachloride	µg/L	5	5	5	5	5	5	5	5	5
Bromodichloromethane	µg/L	5	5	5	5	5	5	5	5	5
2-Chloroethylvinylether	µg/L	10	10	10	10	10	10	10	10	10
1,2-Dichloropropane	µg/L	5	5	5	5	5	5	5	5	5
cis-1,3-Dichloropropene	µg/L	5	5	5	5	5	5	5	5	5
Trichloroethene	µg/L	5	5	5	5	5	5	5	5	24
Benzene	µg/L	5	5	69	24	28	11	5	5	5
trans-1,3-Dichloropropene	µg/L	5	5	5	5	5	5	5	5	5
Dibromochloromethane	µg/L	5	5	5	5	5	5	5	5	5
1,1,2-Trichloroethane	µg/L	5	5	5	5	5	5	5	5	5
Bromoform	µg/L	5	5	5	5	5	5	5	5	5
Tetrachloroethene	µg/L	5	5	5	5	5	5	5	5	5
1,1,2,2-Tetrachloroethane	µg/L	5	5	5	5	5	5	5	5	5
Toluene	µg/L	5	5	5	5	5	5	5	5	5
Chlorobenzene	µg/L	5	5	590	22	48	5	5	5	5
Ethylbenzene	µg/L	5	5	17	5	5	5	5	5	5
METALS										
Cadmium	µg/L	10	10	10	10	10	10	10	NA	10
Copper	µg/L	25	48.7	25	25	25	25	25	NA	25
Lead	µg/L	3	12.9	3	3	3	3	3	NA	4.1
Zinc	µg/L	20	3750	54.5	184	176	616	27.8	NA	5720

APPENDIX A-9

PUBLIC HEALTH RISK EVALUATION PROCESS

APPENDIX A-9. PUBLIC HEALTH RISK EVALUATION PROCESS

INTRODUCTION

Risk Assessment is an essential component of the Remedial Investigation Feasibility Study (RI/FS) process at hazardous waste sites. The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP: the regulation that implements CERCLA), require that actions selected to remedy hazardous waste sites be protective of human health and the environment. An overview of risk assessment in the RI/FS process is presented in the NCP and in the EPA manual <u>Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA</u> (USEPA 1988b). A baseline risk assessment is conducted as part of the RI to assess site conditions in the absence of remedial actions. As part of the FS process, risk assessment is used to evaluated the acceptability of proposed remedial actions and as a tool in the development of remediation objectives (target cleanup levels).

A preliminary baseline public health risk assessment has been conducted for waste sites under evaluation at the CPS/Madison waste site. The public health risk assessment at CPS/Madison examines the presence and release of chemicals from the sites under investigation, the observed levels of the compounds in the environment, the potential routes of exposure to human receptors, and the likelihood of adverse health effects following contact with contaminated environmental media. A detailed overview of the assessment methods used is presented in the following discussion. The focus of this evaluation is not an absolute assessment of the risks of exposure to the chemicals present at the sites under investigation. Rather, this evaluation is an assessment of the relative magnitude of anticipated health problems that may be associated with exposure to chemicals detected at the site. The intention is to determine if there is a significant threat to human health and to assess the need for further site remediation.

OVERVIEW OF METHODS

The general approach to public health risk evaluation of exposure to chemical contaminants has been well-established. The National Research Council (NRC) prepared a comprehensive overview of the structure of this assessment (NRC 1983) that has become the foundation for subsequent EPA guidance. The <u>Human Health Evaluation Manual</u> and the <u>Environmental Evaluation Manual</u> (USEPA 1989a,b) provide a detailed presentation of the risk assessment process. These documents are the Agency's key guidance on risk assessment under the Superfund Program. As specified by EPA, the public health evaluation process may be divided into four fundamental component analyses: (1) data evaluation and hazard identification, (2) exposure assessment, (3) toxicity or hazard assessment, and (4) risk characterization. These analyses are briefly described in the following sections.

Data Evaluation and Hazard Identification

The first step in the risk assessment process is to obtain and evaluate all available data on contaminants present at the sites under investigation. The objective is to organize the data into a form appropriate for the baseline risk assessment. Once the preliminary data set has been obtained and sorted by environmental medium, the following evaluation steps should be completed:

- Evaluate the analytical methods used to determine if results are appropriate for use in quantitative risk assessment.
- Evaluate the quality of data with respect to sample quantitation and detection limits.
- Examine laboratory qualifiers assigned to monitoring data and evaluate potential QA/QC problems.
- Evaluate the quality of data with respect to blanks, and tentatively identified compounds (TICs).
- Summarize information on background concentrations of chemicals and compare with observed levels of site-related contamination.
- Identify chemicals of potential concern: develop a data set that may be appropriately used in the risk assessment process.
- If appropriate, further limit the number of chemicals to be used as the subject of the risk assessment.

From the full listing of all chemicals identified at a waste site or facility, a subset may be identified that is of sufficient quality to be used in risk assessment. Representative "highest risk" compounds may be selected on the basis of: (1) quantities present at the site; (2) extent of environmental contamination, toxicity, or hazardousness; and (3) mobility and persistence of the chemical in the environment. This final step is specified as optional by EPA, and does not improve the quality or accuracy of the risk assessment. It is suggested as a device for facilitating the risk assessment process when time and resources prohibit the evaluation of the full (and often complex) data set (USEPA 1989a).

Exposure Assessment

General Approach and Receptors at Risk

The objectives of the exposure assessment are to: (1) delineate exposure pathways; (2) identify receptors at risk; and (3) measure or estimate for each receptor the intensity, duration, and frequency of the exposure. Critical to the exposure assessment is a quantification of the releases of contaminants of concern to each environmental medium (from all sources at the waste site) and an assessment of the transport and transformation of the subject compounds. The results of these analyses provide data on the magnitude and extent of contamination. Both monitoring data and environmental transport modeling typically are used in the exposure assessment.

EPA has specified that actions at hazardous waste sites should be based on an estimate of the reasonable maximum exposure (RME) expected to occur under both current and future land-use conditions (USEPA 1989a). EPA defines the reasonable maximum exposure as the highest exposure that is reasonably expected to occur at a site. RMEs are estimated for individual pathways, and combined across across exposure routes if appropriate.

Once receptors at risk are identified, environmental concentrations at points of exposure must be determined or projected. In the evaluation of CPS/Madison, exposure concentrations are based completely on the results of site monitoring. No transport modeling has been used. Representative concentrations for use in risk assessment are taken as the arithmetic mean of the sampling results. "Not detected" results were treated as one half the limit of detection and included in calculation of the arithmetic mean.

Dose estimates (in mg/kg/day) are developed for each chemical of concern using the representative environmental concentrations (i.e., mean values). Estimates of dose are needed in the risk characterization and are generally determined as follows:

$$\text{Dose} = C \times \frac{CR \times EFD \times ABS}{BW \times AT}$$

Where

C	=	Chemical concentration in the environmental medium under evaluation.
CR	=	Contact rate; the amount of contaminated medium contacted per unit time or event.
EFD	=	Exposure frequency and duration; how long and often exposure occurs.
ABS	=	Absorption factor
BW	=	Body weight; the average over the exposure period.

and,

AT	=	Averaging time; the period over which exposure is averaged.

The equation above is used to derive estimates of subchronic or chronic dose (lifetime assumed to be 75 years). The chronic dose estimate based on mean concentrations in environmental samples (arithmetic mean) was used as the basis of the risk characterization at all sites under investigation.

Comparison with Applicable or Relevant and Appropriate Requirements

Once the baseline concentrations of subject chemicals have been determined at the waste sites, these levels are compared to applicable or relevant and appropriate requirements (ARARs). CERCLA of 1980 as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986 requires the selection of remedial actions at Superfund hazardous waste sites that are protective of human health and the environment, cost-effective, and technologically and administratively feasible. Section 121 of CERCLA specifies that response action must be undertaken in compliance with ARARs established in Federal and state environmental laws.

In the revised National Contingency Plan (NCP: 55 FR 8666) and the guidance document CERCLA Compliance with Other Laws Manual (USEPA 1988, 1989d), several different types of requirements are identified with which Superfund remedial actions must comply: (1) ambient or chemical-specific requirements, (2) action-specific requirements, and (3) location-specific requirements. Because situations at CERCLA sites vary widely, EPA cannot categorically specify requirements that will be ARARs for every NPL site. ARARs can only be identified on a site-specific basis (i.e., established in connection with the characteristics of the particular site, the chemicals present at the site, and the remedial alternatives suggested by the circumstances of the site).

In the RI/FS process, the evaluation of remedial alternatives must consider effectiveness, implementability, and cost. Within the context of the effectiveness evaluation, chemical-specific ARARs assume major significance. Each alternative is evaluated with regard to effectiveness in protecting human health and the environment. Effectiveness criteria include protectiveness and the envisioned reduction of toxicity, mobility, or volume through treatment.

According to the guidance presented in the revised NCP, protectiveness (i.e., the ability to protect human health and the environment) means that a given remedial alternative meets or exceeds ARARs, or other risk-based levels established through a risk assessment when ARARs do not exist or are waived. (Note that compliance with chemical-specific is not required for interim remedies. 55 FR 8666). In the NCP and in the guidance manual on CERCLA compliance with other laws (55 FR 8666, USEPA 1988a, 1989d), EPA specifies that when ARARs are not available for a given chemical, or where such ARARs are not sufficient to be protective, health advisory levels should be identified or developed in order to ensure that a remedy is protective.

For carcinogenic effects, these health advisory or cleanup levels are to be selected such that the total risk of all contaminants falls within the acceptable range of 10^{-4} to 10^{-6}. Although the 10^{-6} risk level is identified by EPA as a "point of departure" in evaluating the results of risk assessment, the revised NCP clearly indicates that the 10^{-4} level is the upper bound of the acceptable range (55 FR 8666). In cases where noncarcinogenic effects are a concern, EPA specifies that cleanup should be based on acceptable levels of exposure as determined by the EPA reference doses (RfDs), taking into account the effects of multiple contaminants and multiple exposure pathways at the site.

Therefore, chemical-specific ARARs serve two primary purposes: (1) requirements that must be met by a selected remedial alternative (unless a waiver is obtained), and (2) as a basis for establishing appropriate cleanup levels. The public health risk assessment of a given remedial action alternative characterizes the actual risk of exposure of human receptors to contaminants under investigation. For carcinogens, risk characterization yields a probabilistic estimate of the additional lifetime risk of cancer in the exposed individual or the incidence of new cases of cancer in populations. For noncarcinogens, exposure levels or doses for all subject compounds are evaluated to determine levels or doses if these exceed EPA RfDs. When an ARAR is available for all subject compounds of concern, and the ARARs are determined to be protective, these requirements become the chemical-specific cleanup goals. However, as noted above, when ARARs are found not to be protective or are not available, the results of the risk assessment (i.e., health advisory levels) are used to establish the more stringent target cleanup goals.

Thus, the requirement that a remedial alternative meet chemical-specific ARARs does not ensure that the proposed alternative is protective, and thereby potentially acceptable. This can be determined only by: (1) evaluating the combined carcinogenic risk associated with the ARAR limits for all chemicals at a given site (assuming additivity of effect in the absence of data on synergism or antagonism); (2) establishing that ARARs do not exceed USEPA RfDs for noncarcinogenic effects, and are sufficiently protective when multiple chemicals are present; (3) determining whether environmental effects (in addition to human health considerations) are adequately addressed by the ARARs; and (4) evaluating whether the ARARs adequately cover all significant pathways of human exposure identified in the baseline risk assessment. EPA has provided guidance on evaluating multiple exposure to chemicals (carcinogenic and noncarcinogenic effects) and on establishing acceptable exposure levels when no ARARs exist (USEPA 1986c, 1989a).

Toxicity Assessment

The objectives of the toxicity or hazard assessment are to evaluate the inherent toxicity of the compounds under investigation, and to identify and select toxicological measures for use in evaluating the significance of the exposure. In the development of these toxicological measures, available dose-response data are reviewed on the adverse effects to human and nonhuman receptors. Dose-response assessments for noncarcinogens provide an estimate of the no-observable-adverse-effect level (NOAEL) or lowest-observable-adverse-effect level (LOAEL). For carcinogenic compounds, the dose-response assessment yields estimates of probability or range of probabilities under which a carcinogenic effect will occur at a specified level of exposure.

In conducting an assessment of risk of exposure to chemicals released from waste sites, several toxicity measures of importance may be identified:

- RfDs for oral exposure - acceptable intake values for subchronic and chronic exposure (noncarcinogenic effects)

- RfDs for inhalation exposure - acceptable intake values for subchronic and chronic exposure (noncarcinogenic effects)

- Carcinogenic potency factors for oral exposure

- Carcinogenic potency factors for inhalation exposure.

The RfDs and potency factors for oral exposure are the toxicity measures needed in the assessment for CPS/Madison. Long-term (i.e., chronic) exposure and health risk is the focus of the evaluation at all sites.

The primary sources of information for these data is the Integrated Risk Information System (IRIS) data base. IRIS is a computer-housed catalog of EPA risk assessment and risk management information for chemical substances. Data in the IRIS system is regularly reviewed and updated monthly. If toxicity measures are not available on IRIS, EPA recommends use of the EPA ORD Health Effects Assessment Summary Tables (HEAST: FY 1989. USEPA 1989c) as the second most current source of information. SAIC has on-line access to the IRIS Data Base and receives the quarterly HEAST publications from EPA ORD. Therefore, the risk assessment is based on the most up-to-date EPA-approved toxicity measures available for waste site evaluation.

A summary of the toxicity measures used in the evaluation of the waste sites at CPS/Madison is presented in Table A-1. Toxicity measures for chronic oral and inhalation exposure are used in the baseline risk assessmet. The table provides a comprehensive list of RfDs (chronic and subchronic when available), carcinogenic potency factors (oral and inhalation routes), weight of evidence ratings, and sources of information.

Risk Characterization

The last step in the baseline public health evaluation is risk characterization. This is the process of integrating the results of the exposure and hazard (toxicity) assessment (i.e., of comparing estimates of dose with appropriate toxicological endpoints to determine the likelihood of adverse effects in exposed populations). It is common practice to consider risk characterization separately for carcinogenic and noncarcinogenic effects. This is due to a fundamental difference in the way organisms typically respond following exposure to carcinogenic or noncarcinogenic agents. For noncarcinogenic effects, toxicologists recognize the existence of a threshold of exposure below which there is only a very small likelihood of adverse health impacts in an exposed individual. Exposure to carcinogenic compounds, however, is not thought to be characterized by the existence of a threshold. Rather, all levels of exposure are considered to carry a risk of adverse effect.

The procedure for calculating risk associated with exposure to carcinogenic compounds has been established by EPA (USEPA 1986b,c; USEPA 1989a). A non-threshold, dose-response model is used to calculate a carcinogenic potency

TABLE A-1. TOXICITY MEASURES FOR WASTE SITE EVALUATION: INGESTION AND INHALATION PATHWAYS

COMPOUND	Noncarcinogenic Effects Oral Route (mg/kg/day) RfD-S (a)	RfD-C (b)	Source (Oral)	Noncarcinogenic Effects Inhalation Route (mg/kg/day) RfD-S (a)	RfD-C (b)	Source (Inhal.)	Noncarcinogenic Effect of Concern	Carcinogenic Potency Factor (q1*): Oral Exposure (mg/kg/day)-1	Source (Oral)	Carcinogenic Potency Factor (q1*): Inhalation Exposure (mg/kg/day)-1	Source (Inhal.)
INORGANICS											
Cadmium	- -	5.00E-04	d	- -	5.00E-04	d,j	Kidney			6.10E+00 [B1]	d
Copper	3.70E-02	3.70E-02	d,e	- -	3.70E-02	d,e,j	GI Tract, Blood				
Lead	- -	1.40E-03	d,m	- -	1.40E-03	d,j	CNS, Kidney				
Zinc	2.00E-01	2.00E-01	d	- -	2.00E-01	d,j	GI Tract				
ORGANICS											
Acrolein	- -	- -		1.00E-03	1.00E-04	d	Lung, Kidney			[C]	
Acrylonitrile	- -	- -		- -	- -		Lung, CNS	5.40E-01 [B1]	d	2.40E-01 [B1]	d
Benzene	- -	3.60E-04	s	- -	- -		Hematopoietic Sys.	2.90E-01 [A]	d	2.90E-01 [A]	d
Bromodichloromethane	- -	2.00E-02	c	- -	- -		Liver, Kidney, CNS	1.30E-01 [B2]	d		
Bromoform	2.00E-01	2.00E-02	d	2.00E-01	2.00E-02	d,j	Liver	7.90E-03 [B2]	d		
Bromomethane	1.00E-02	1.00E-03	d	6.00E-02	6.00E-02	d	CNS				
Carbon Tetrachloride	7.00E-03	7.00E-04	d	7.00E-03	7.00E-04	d,j	Liver	5.20E-02 [B2]	d	1.30E-01 [B2]	d
Chlorobenzene	2.00E-01	2.00E-02	d	5.00E-02	5.00E-03	d	Liver, Kidney				
Chloroform	1.00E-02	1.00E-02	d	1.00E-02	1.00E-02	d,j	Liver, Kidney, CNS	6.10E-03 [B2]	d	8.10E-02 [B2]	d
Chloroethane	1.00E+00	1.00E-01	d,t	1.00E+00	1.00E-01	d,t	Liver, Kidney, CNS				
Chloromethane	- -	- -		- -	- -		Liver, Kidney, CNS	1.30E-02 [C]	d	6.30E-03 [C]	d
Dibromochloromethane	2.00E-01	2.00E-02	d	- -	- -		Liver				
1,1-Dichloroethane	1.00E+00	1.00E-01	d	1.00E+00	1.00E-01	d	Liver, Kidney, CNS	9.10E-02 [B2]	d	9.10E-02 [B2]	d,j
1,2-Dichloroethane	1.00E+00	1.00E-01	d,h	1.00E+00	1.00E-01	d,h	Liver, Kidney, CNS	9.10E-02 [B2]	d	9.10E-02 [B2]	d
1,1-Dichloroethylene	9.00E-03	9.00E-03	d	- -	- -		Liver, Kidney, CNS	6.00E-01 [B2]	d	1.20E+00 [B2]	d
1,2-Dichloroethylene	9.00E-03	9.00E-03	d,f	- -	- -		Liver, Kidney, CNS				
1,2-Dichloropropane	- -	- -		- -	- -		Liver, Kidney, CNS	6.80E-02 [B2]	d	[B2]	
1,3-Dichloropropene	3.00E-03	3.00E-04	d	1.00E-02	1.00E-02	d	Liver	1.80E-01 [B2]	d		
Ethylbenzene	1.00E+00	1.00E-01	d	- -	- -		Skin, Liver, Kidney				
Methylene Chloride	6.00E-02	6.00E-02	d	6.00E-02	6.00E-02	d,j	Liver, Kidney, CNS	7.50E-03 [B2]		4.70E-07 [B2]	d
1,1,2,2-Tetrachloroethane	- -	- -		- -	- -		Liver	2.00E-01 [C]	d	2.00E-01 [C]	d
Tetrachloroethylene	1.00E-01	1.00E-02	d	1.00E-01	1.00E-02	d,j	Liver, Kidney, CNS	5.10E-02 [B2]	d	3.30E-03 [B2]	d
Toluene	4.00E-01	3.00E-01	d	2.00E+00	2.00E+00	d	CNS				
1,1,1-Trichloroethane	9.00E-01	9.00E-02	d	3.00E+00	3.00E-01	d	CNS, Lung, Kidney				
1,1,2-Trichloroethane	4.00E-02	4.00E-03	d	3.00E+00	3.00E-01	d,p	CNS, Lung, Kidney	5.70E-02 [C]	d	5.70E-02 [C]	d
Trichloroethylene	1.00E-01	1.00E-02	d,g	1.00E-01	1.00E-02	c,k,j	Liver, Kidney, CNS	1.10E-02 [B2]	d	1.70E-02 [B2]	d
Trichlorofluoromethane	3.00E+01	3.00E+01	d,r	- -	- -		CNS				
Vinyl Chloride	- -	1.30E-03	q	- -	- -		Blood, Liver, CNS	2.30E+00 [A]	d	2.95E-01 [A]	d

a. RfD=Reference dose for subchronic (short-term) exposure.
b. RfD=Reference dose for chronic (long-term) exposure.
c. IRIS DATA BASE
d. USEPA ORD Health Effects Assessment Summary Tables (HEAST) FY 1989, 4th Quarter.
e. RfD derived from the USEPA drinking water standard as listed in USEPA 1989 HEAST 2nd Quarter report.
f. In the absence of toxicity data, the RfDs for 1,1-Dichloroethylene have been adopted for 1,2-Dichloroethylene.
g. In the absence of toxicity data, the RfDs for PCE have been adopted for TCE.
h. In the absence of toxicity data, the RfDs for 1,1-Dichloroethane have been adopted for 1,2-Dichloroethane.
j. RfDs or potency factors for the oral exposure route have been used in the absence of toxicity data for the inhalation route.
k. In the absence of toxicity data, the reference dose for tetrachloroethylene is used for trichloroethylene.
m. Reference dose for lead is under evaluation by EPA. The RfD listed is this table has been used in the absence of a more recent toxicity measure.
p. In the absence of toxicity data, the inhalation RfDs for 1,1,1-Dichloroethane have been adopted for 1,1,2-Dichloroethane.
q. Reference dose for vinyl chloride was derived from the EPA ODW longer-term drinking water health advisory.
r. In the absence of toxicity data, the reference dose for trichlorotrifluoromethane has been adopted.
s. RfD for chronic exposure to 70 kg adult derived from EPA ADI of 0.025 mg/day. Drinking Water Criteria Document for Benzene (USEPA 1985), EPA ODW.
t. In the absence of toxicity data, the reference doses for 1,1-dichloroethane has been adopted.

factor (which mathematically is the slope of the dose-response curve) for each chemical. To derive an estimate of risk, the carcinogenic potency factor (q_1* - defined below) is then multiplied by the estimated chronic daily dose experienced by the exposed individual:

$$\text{Risk} = \text{CDI} \times q_1^*$$

where

Risk = Upper bound estimate of the excess lifetime cancer risk to an indivdual (unitless probability).

CDI = Chronic daily dose averaged over a 70 year period (mg/kg body weight/day)

and,

q_1* = 95% upper-bound estimate of the slope of the dose-response curve $(\text{mg/kg body weight/day})^{-1}$

The slope factor q_1^* is used to convert estimates of daily intake or dose averaged over a lifetime, to incremental excess risk of an individual developing cancer. EPA notes that use of this equation assumes that the dose-response relationship is linear in the low-dose portion of the multistage model dose-response curve (USEPA 1989a: A linearized multistage dose response model is most commonly used by EPA in deriving the slope estimates.) Given this assumption, the slope factor is a constant and risk is directly proportional to intake.

EPA indicates that use of the linear equation (above) for risk estimation is valid only at risk levels $< 1 \times 10^{-2}$. The Agency recommends use of the following equation (based on the "one-hit" model of carcinogenesis) as an alternative at sites where exposure and intakes are projected to be quite high, and risk levels may exceed 1×10^{-2}.

$$\text{Risk} = 1 - \exp(-\text{CDI} \times q_1^*)$$

In evaluating risk of exposure to more than one carcinogen, the risk measure for each compound may be summed (in the absence of information on antagonistic or synergistic effects) to provide an overall estimate of total carcinogenic risk (USEPA 1989a).

$$Risk_T = \sum_{i=1}^{n} Risk_i$$

where

$Risk_T$ = The combined excess lifetime cancer risk across chemical carcinogens.

and,

$Risk_i$ = The risk estimate for the i^{th} chemical of n chemicals under evaluation.

This is conducted for each source of environmental release, associated exposure pathway, and receptor group at risk of exposure. Population risks are derived by multiplying the overall risk level (summed for all subject chemicals) by the number of people exposed. This would yield a measure of the additional incidence of developing cancer (i.e., additional number of new cases) in the exposed population over a lifetime (i.e., 70 years) of exposure.

The traditionally accepted practice of evaluating exposure to noncarcinogenic compounds has been to experimentally determine a NOAEL and to divide this by a safety factor to establish an acceptable human dose, for example, acceptable daily intake or RfD (NRC 1983). The RfD is then compared to the average daily dose experienced by the exposed population to obtain a measure of concern for adverse noncarcinogenic effects:

$$HQ = \frac{Dose}{RfD}$$

where

HQ = Hazard Quotient: potential for adverse noncarcinogenic effects

Dose = average daily dose for subchronic or chronic exposure (mg/kg body weight/day)

and,

RfD = acceptable intake for subchronic or chronic exposure (mg/kg body weight/day)

Dose and the RfD are expressed in the same units and are based upon common exposure periods (i.e., chronic, subchronic, or shorter-term). If HQ is > 1, then there may be potential for adverse noncarcinogenic effects at the given exposure/dose level. Guidelines for evaluating exposure to mixtures of noncarcinogens is presented by EPA (USEPA 1986b, USEPA 1989a). Essentially, this involves summing the hazard quotient (ratios of daily dose/RfD) for all chemicals under evaluation. If the sum of these ratios, called the Hazard Index (HI) is > 1, then there is the potential for adverse noncarcinogenic effects. Under these circumstances, EPA recommends segregating the compounds into groups of like or common toxicological effects, and again to evaluate the potential for manifestation of the various adverse health effects identified.

REFERENCES

Integrated Risk Information System 1989 US Environmental Protection Agency on-line data base of toxicity measures. Office of Research and Development, Environmental Criteria and Assessment Office, Cincinnati, OH. Electronic Mail Account information via Dialcom, Inc. 600 Maryland Ave, SW, Washington, D.C.

NRC 1983 Risk Assessment in the Federal Government: Managing the Process. National Research Council. National Academy Press, Washington, D.C.

USEPA 1985 Development of Statistical Distributions or Ranges of Standard Factors Used in Exposrue Assessments Prepared by GCA Corp, Chapel Hill for the US Environmental Protection Agency. PB85-242667

USEPA 1986a Superfund Public Health Evaluation Manual. US Environmental Protection Agency, Office of Emergency and Remedial Response, Washington, D.C. EPA 540/1-86/060

USEPA 1986b Guidelines for Carcinogenic Risk Assessment. US Environmental Protection Agency. Federal Register 51(185):33991-34003

USEPA 1986c Guidelines for the Health Risk Assessment of Chemical Mixtures. US Environmental Protection Agency. Federal Register 51(185):34014-34025

USEPA 1987 Superfund Program: Interim Guidance on Compliance with Other Applicable or Relevant and Appropriate Requirements. Federal Register 52(166):32496-32499.

USEPA 1988a CERCLA Compliance with Other Laws Manual. US Environmental Protection Agency, Office of Emergency and Remedial Response. OSWER Directive 9234.1-01

USEPA 1988b Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA. US Environmental Protection Agency, Office of Solid Waste and Emergency and Remedial Response. OSWER Directive 9335.3-01

USEPA 1988c Draft Interim Guidance on Estimating Inhalation Exposure During Showering. US Environmental Protection Agency, Office of Research and Development, Februrary 6, 1988.

USEPA 1989a Risk Assessment Guidance for Superfund: Human Health Evaluation Manual Part A. US Environmental Protection Agency, Office of Solid Waste and Emergency and Remedial Response. OSWER Directive 9285.701A

USEPA 1989b Risk Assessment Guidance for Superfund: Volume II Environmental Evaluation Manual. US Environmental Protection Agency, Office of Solid Waste and Emergency and Remedial Response. EPA/540/1-89/001

USEPA 1989c Health Effects Assessment Summary Tables Fourth Quarter FY 1989 US Environmental Protection Agency, Office of Research and Development. OERR 9200.6-303-(89-4)

USEPA 1989d CERCLA Compliance with Other Laws Manual Part II. US Environmental Protection Agency, Office of Emergency and Remedial Response. OSWER Directive 9234.1-01

USEPA 1989e Expsure Factors Handbook US Environmental Protection Agency, Office of Health and Environmental Assessment. EPA/600/8-89/043

USEPA 1990 National Oil and Hazardous Substances Pollution Contingency Plan (NCP). Federal Register 55(46):8666-8865.

APPENDIX B-1

TECHNOLOGY DESCRIPTIONS

APPENDIX B

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Solidification

o In-situ Vitrification

In-situ vitrification is a technology being developed for the stabilization of transuranic contaminated wastes, and has conceivable applicable to other hazardous wastes. Several laboratory-scale and pilot-scale tests have been conducted, and a large-scale testing system is currently being fabricated. The technology is based upon electric melter technology, and the principle of operation is joule heating, which occurs when an electrical current is passed through a molten mass. Contaminated soil is converted into durable glass, and wastes are paralyzed or crystallized. Off-gases released during the melting process are trapped in an off-gas hood. The depth of the waste is a significant limiting factor in the application of this technology.

o Solidification/Stabilization

Solidification and stabilization are terms which are used to describe treatment systems which (1) improve waste handling or other physical characteristics of the waste, (2) decrease the surface area across which transfer of contaminants can occur and/or (3) limit the solubility or toxicity of contaminants. Solidification is used to describe processes where these results are obtained primarily, but not exclusively, by production of a monolithic block of waste with high structural integrity. The contaminants do not necessarily interact chemically with the solidification reagents, but are mechanically locked within the solidified matrix. Contaminant loss is minimized by reducing the surface area. Stabilization methods usually involve the addition of materials which limit the solubility or mobility of waste constituents even though the physical handling characteristics of the waste may not be improved. Methods involving combinations of solidification and stabilization techniques are often used. The state-of-the-art of solidification/stabilization methods is advancing rapidly. Many manufacturers are marketing processes which involve the use of various combinations of alkaline earth materials often together with organic polymers and proprietary chemicals.

o Cement-based Solidification

Cement-based solidification involves mixing the wastes directly with Portland cement. The waste is incorporated into the rigid matrix of the hardened concrete. The end product may be a standing monolithic solid or may have a crumbly, soil-like consistency, depending upon the amount of cement added.

Most hazardous wastes slurried in water can be mixed directly with cement and the suspended solids will be incorporated into the rigid matrix. Although cement can physically incorporate a broad range of waste types, most wastes will not be chemically bound and are subject to leaching. Cement solidification is most suitable for immobilizing metals because at the pH of the cement mixture, most multivalent cations are converted into insoluble hydroxides or carbonates.

There are many disadvantages to cement-based solidification. Metal hydroxides and carbonates are insoluble only over a narrow pH range and are subject to solubilization and leaching in the presence of even mildly acidic leaching solutions (i.e., rain). Portland cement alone is not effective in immobilizing organics. Cement-based solidification results in wastes that are twice the weight and volume of the original material thereby increasing transportation and disposal costs. Some wastes are incompatible with cement such as some sodium salts (i.e., arsenate, borate, phosphate, iodate, and sulfide), salts of magnesium, tin, zinc, copper, and lead, organic matter, some silts and clays, coal and lignite. The major advantage of the method is its low cost and the use of readily available mixing equipment.

o Silicate-Based Solidification

Silicate based processes refer to a very broad range of solidification and stabilization methods which use a siliceous material together with lime, cement, gypsum, and other suitable setting agents. Extensive research is currently underway on the use of siliceous compounds in solidification. Many of the available processes use proprietary additives and claim to stabilize a broad range of compounds. The basic reaction is between the silicate material and polyvalent metal ions. The silicate material which is added in the waste may be fly-ash, blast furnace slag or other readily available materials. Soluble silicates such as sodium silicate or potassium silicate are also used. The polyvalent metal ions which act as initiators of silicate precipitation and/or gelation come either from the waste solution, an added settling agent, or both. The setting agent should have low solubility, and a large reserve capacity of metallic ions so that it controls the reaction rate. Portland cement and lime are most commonly used because of their ready availability. However, gypsum, calcium carbonate, and other compounds containing aluminum, iron, magnesium are also suitable. The solid which is formed in these processes varies from a moist, clay-like material to a hard-dry solid similar in appearance to concrete. There are a number of silicate-based processes which are currently available or in the research stages. Manufacturers' claims differ significantly in terms of the capabilities of these processes for stabilizing different waste constituents.

One of the major limitations with silicate based processes is that a large amount of water which is not chemically bound will remain in the solid after solidification. In open air, the liquid will leach until it comes to some equilibrium moisture content with the surrounding soil. Because of this water loss, the solidified product is likely to require secondary containment.

Commercial cement mixing and handling equipment can generally be used for silicate-based processes. A number of mobile, trailer mounted systems are available.

o Sorbents

Sorbents include a variety of natural and synthetic solid materials which are used to eliminate free liquid and improve the handling characteristics of wastes. Commonly used natural sorbent materials include fly ash, kiln dust, vermiculite, and bentonite. Synthetic sorbent materials include activated carbon which sorbs dissolved organics, Hazorb (Dow Chemical) which sorbs water and organics and Locksorb (Redecca Corporation) which is reportedly effective for all emulsions.

Sorbents are widely used to remove free liquid and improve waste handling. Some sorbents have been used to limit the escape of volatile organic compounds. They may also be useful in waste containment when they modify the chemical environment and maintain the pH and redox potential to limit the solubility of wastes. Although sorbents prevent drainage of free water, they do not necessarily prevent leaching of waste constituents and secondary containment is generally required. Equipment requirement for addition and mixing of sorbents are simple.

o Thermoplastic Solidification

Thermoplastic solidification involves sealing wastes in a matrix such as asphalt bitumen, paraffin, or polyethylene. The waste is dried, heated, and dispensed through a heated plastic matrix. The mixture is then cooled to form a rigid but deformable solid. Bitumen solidification is the most widely used of the thermoplastic techniques.

Thermoplastic solidification involving the use of an asphalt binder is most suitable for heavy metal or electroplating wastes. Relative to the cement solidification, the increase in volume is significantly less and the rate of leaching significantly lower. Thermoplastics are not affected significantly by either water or microbial action

There are a number of waste types which are incompatible with thermoplastic solidification. Oxidizers such as perchlorates or nitrates can react with many of the solidification materials to cause an explosion. Some solvents and gases can cause asphalt materials to soften and never become rigid. Xylene and toluene diffuse quite rapidly through asphalt. Salts that partially dehydrate at elevated temperatures can be a problem. Sodium sulfate hydrate, for example, will loose some water during asphalt incorporation and if the waste asphalt mix containing the partially dehydrated salt is soaked in water, the mass will swell and crack due to rehydration. This can be avoided by eliminating easily dehydrated salts or coating the outside of the waste/asphalt mass with pure asphalt. Chelating and complexing agents can cause problems with containment of heavy metals. Certain wastes, such as tetraborates, and iron and aluminum salts can cause premature solidification and plug up the mixing machinery.

High equipment and energy costs are principal disadvantages of thermoplastic solidification. Another problem is that the plasticity of the matrix-waste mixture generally require that containers be provided for transportation and disposal of materials which greatly increases the cost. Thermoplastic solidification requires specialty equipment and highly trained operators to heat and mix the wastes and solidifier. The common range of operating temperatures is 130 to 230 degrees centigrade. The energy intensity of the operation is increased by the requirement that the wastes be thoroughly dried before solidification.

o Surface Microencapsulation

Surface encapsulation includes those methods which physically microencapsulate wastes by sealing them in an organic binder or resin. Surface encapsulation can be accomplished using a variety of approaches.

A process developed by Environmental Protection Polymers involves the use of 1,2-polybutadiene and polyethylene to produce a microencapsulated waste block onto which a high density polyethylene (HDPE) jacket is fused. The 1,2-polybutadiene is mixed with particulated waste which yields, after solvent evaporation, free flowing dry resin-coated particulates. The resulting polymers are resistent to oxidative and hydrolytic degradation and to permeation by water. The next step involves formation of a block of the polybutadiene/waste mixture. In the final step, a 1/4 inch thick HDPE jacket is mechanically and chemically locked to the surface of the microencapsulated waste. An alternative process developed by the same company involves a similar approach. Contaminated solids or sludges are loaded into a high density polyethylene overpack. A portable welding apparatus in then used to spin weld a lid onto the container forming a seam free encapsulate.

Another encapsulation method uses an organic binder to seal a cement-solidified mass. United States Gypsum Company manufactures a product called Envirostone Cement which is a special blend of high-grade polymer modified-gypsum cement.

Emulsifiers and ion exchange resins may be added along with the gypsum cement which hydrates to form a freestanding mass. A proprietary organic binder is used to seal the solidified mass. The process can be used to stabilize both organic and inorganic wastes.

The major advantage of encapsulation processes is that the waste material is completely isolated from leaching solutions. These methods can be used for both organic and inorganic waste constituents. They allow for efficient space utilization during transport, storage and disposal. The hazard of accidental spills during transport is eliminated. Encapsulation materials are commercially available, very stable chemically, nonbiodegradable, mechanically tough and flexible. They can withstand the mechanical and chemical stresses of a wide range of disposal schemes.

The disadvantages of encapsulation techniques include the high cost of the binding resins and that the processes are energy intensive. In addition skilled labor is required to operate molding and fusing equipment.

o Vitrification

Vitrification of wastes involves combining the wastes with molten glass at a temperature of 1,350 degrees centigrade or greater. There are some processes that allow temperatures as low as 850 degrees centigrade.

Vitrification is quite costly and so far has been restricted to radioactive or very highly toxic wastes. To be considered for vitrification, the wastes should be either stable or totally destroyed at the process temperature.

Vitrification offers the greatest degree of containment of all the common solidification methods. Most resultant solids have an extremely low leach rate. Some glasses, such as borate-based glasses, have high leach rates and exhibit some water solubility. The high energy demand and requirements for specialized equipment and trained personnel greatly limit the use of this method.

Bioreclamation

Microorganisms, like all living organisms, require specific inorganic nutrients (i.e., nitrogen, phosphate-phosphorus, trace metals), and a carbon and energy source to survive. Bioreclamation relies upon microbial metabolic activity to convert toxic substances to a more desirable form. Indigenous microorganisms can generally be relied upon to degrade a wide range of compounds given an adequate living conditions. Specially adapted or genetically manipulated microorganism are also available. The technology of in-situ bioreclamation involves implementing methods to optimize environmental conditions to the subsurface to enhance microbial activity. This can include an injection well, an infiltration system or other techniques to provide oxygen, provide nutrients, control temperature or modulate any other parameter that can enhance microbial activity.

Bioreclamation cam be expected to reduce the concentration of only those organic compounds which are amenable to biological degradation. These are compounds that are either substrates for microbial growth and metabolism, or are cometabolically broken down as the microorganism uses another primary substrate as its carbon and energy source. Microbial metabolic activity can be classified into three main categories: aerobic respiration, in which oxygen is required as a terminal electron acceptor; anaerobic respiration, in which sulfate or nitrate serves as a terminal electron acceptor; and fermentation, in which the microorganism rids itself of excess electrons by exuding reduced organic compounds.

The bioreclamation method that has been most developed for in-situ treatment is one which relies on aerobic (oxygen requiring) microbial processes. For most compounds, the most rapid and complete degradation occurs aerobically. It can be generalized that for the degradation of petroleum hydrocarbons, aromatics, halogenated aromatics, polyaromatic hydrocarbons, phenols, halophenols, biphenyls, organophosphates, and most pesticides and herbicides, aerobic bioreclamation techniques are most suitable. Extensive data on the biodegradabilities of substances can be found in the literature. Relative aerobic biodegradability of compounds can also be estimated using laboratory data associated with biological, chemical and ultimate oxygen demand (i.e., BOD, COD, UOD). In most instances, treatability studies are required to determine degradability of specific contaminants.

Aerobic bioreclamation has been demonstrated to be effective in degrading organics at more than 30 spill sites. Although it has not yet been demonstrated at hazardous waste sites, it can be expected to be effective and reliable provided the organics are amenable to aerobic degradation and the hydraulic conductivity of the aquifer is sufficiently high. There are substantial research data to suggest that microorganisms found at uncontrolled hazardous waste sites are well-acclimated to the wastes.

Anaerobic treatment is generally not as promising for site remediation as aerobic treatment. Anaerobic processes are slower; fewer compounds can be degraded, and the logistics of rendering a site anaerobic have not been developed to date. Anaerobic degradation under reducing conditions appears to be the most suitable process for halogenated lower molecular weight hydrocarbons, such as unsaturated alkyl halides like PCE and TCE, and saturated alkyl halides like 1,1,1-trichloroethane and trihalomethane. Some lower molecular weight halogenated hydrocarbons, will only degrade anaerobically.

Relative to conventional pump and treat methods, bioreclamation may be more effective since it is capable of degrading organics sorbed to soils. Sorbed organics are not removed using conventional pump and treat methods.

Chemical Treatment

Chemicals can be used to immobilize, mobilize (for extraction) or detoxify subsurface organic and inorganic contaminants. Technologies placed in the category "immobilization" include precipitation, chelation, and polymerization. The category encompassing methods for mobilizing contaminants for extraction is termed "soil flushing." Flushing agents include surfactants, dilute acids and bases, and water. Detoxification techniques include oxidation, reduction, neutralization, and hydrolysis. These categories do not define the limits of each technology, as a technique implemented primarily for one objective may simultaneously perform one or more others.

In-situ chemical treatment covers a wide range of methods. Generalizations regarding the feasibility and effectiveness of these methods are not possible. However, all these methods are developmental or conceptual and none have been fully demonstrated for hazardous waste site remediation. Off all the methods that will be described, soil flushing methods involving the use of water surfactants appear to be the most feasible for organics. They can use relatively cheap, innocuous treatment reagents, can be used to treat a broad range of waste constituents, and do not result in toxic degradation products. The most feasible methods for treating inorganics in-situ include soil flushing with dilute acids, chelating agents or other treatment agents which will mobilize the metals.

The feasibility of an in-situ chemical treatment approach is dictated by site geology and hydrology, soil characteristics, and waste characteristics. Since the application of many chemical in-situ treatment techniques to hazardous waste disposal site reclamation is conceptual or in the developmental stage, there is little hard data available on the specific site characteristics that may limit the applicability of each method. Some of the site and soil characteristics considered important in evaluating the treatment applicability are as follows:

- o Site location/topography
- o Slope of site-degree and aspect
- o Soil, type and extent
- o Hydraulic properties and conditions
- o Climatological factors

The chemical treatment approaches generally involve the delivery of a fluid to the subsurface. Therefore, the same factors that limit the use of injection/extraction wells, drains, or surface gravity application systems will limit the applicability of most in-situ chemical treatment approaches. Minimal permeability requirements must be met if the treatment solution is to be delivered successfully to the contaminated zone. Sandy soils are far more amenable to in-situ treatment than clayey soils. Further, the contaminated groundwater must be contained within the treatment zone. Measures must be taken to ensure that treatment reagents do not migrate and, of themselves, become contaminants. Care must be taken during the extraction process not to increase the burden of contaminated water by drawing uncontaminated water into the treatment zone from the aquifer or from hydraulically connected surface waters.

Potential chemical reaction of the treatment reagents with the soils and wastes must be considered. Most hazardous waste disposal sites contain a mix of contaminants. A treatment approach that may neutralize one contaminant may render another more toxic or mobile; for example, chemical oxidation will destroy or reduce the toxicity of many toxic organics, but chromium III, if present, will oxidize to the more toxic and mobile chromium VI state. The permeability of soils may be reduced by the treatment approach. In soils high in iron or manganese; for example, oxidizing the subsurface could result in the precipitation of iron and manganese oxides and hydroxides, which could clog the delivery system and the aquifer.

o Soil Flushing

Soil flushing (i.e., solvent flushing, ground leaching, or solution mining) is an extraction process that washes organic and inorganic contaminants from the soil. Water or an aqueous solution is injected into the area of contamination, and the contaminated elutriate is pumped to the surface for removal, recirculation, or on-site treatment and reinjection. During elutriation, sorbed contaminants are mobilized into solution, formation of an emulsion, or by chemical reaction with the flushing solution. Solutions with the greatest potential for use in soil flushing are (1) water, (2) acids-bases, (3) complexing and chelating agents, (4) surfactants and (5) reducing agents. Soil flushing may involve the recycling of elutriate through the contaminated material, with make-up solvent being added to the system while a fraction of the elutriate stream is routed to a wastewater treatment system.

Water can be used to flush water-soluble or water-mobile organics and inorganics. Hydrophilic organics are readily solubilized in water. Organics amenable to water flushing can be identified according to their soil/water partition coefficient, or estimated using the octanol/water coefficient. High solubility organics, such as lower molecular weight alcohols, phenols, and carboxylic acids very amenable to this technique. Medium solubility organics which could be effectively removed from soils by water flushing include low to medium molecular weight ketones, aldehydes, and aromatics, and lower molecular weight halogenated hydrocarbons. Inorganics which can be flushed from soil with water are soluble salts such as the carbonates of nickel, zinc, and copper. Adjusting the pH with dilute solutions of acids or bases will enhance inorganic solubilization and removal.

Dilute solution of acids have been widely used in industrial processes to extract metal ions. Solutions of sulfuric, hydrochloric, nitric, phosphoric, and carbonic acid are used in industrial applications to dissolve basic metal salts. However, because of the toxicity of many acids, it is desireable to use weak acids for in-situ treatment. Acidic solutions may serve to flush some basic organics such as amines, ethers, and anilines.

Complexing and chelating agents may also find use in a solution mining removal system for heavy metals. Chelating agents used for in-situ treatment must result in a stable metal-chelate complex which is resistant to decomposition and degradation. Another possibility for mobilizing metals which are strongly adsorbed to manganese and iron oxides in soils is to reduce the metal oxides, resulting in release of the heavy metal solution. Chelating agents or acids can then be used to keep the metals in solution.

Surfactants can be used to improve the solvent property of the recharge water, emulsify nonsoluble organics, and enhance the removal of hydrophobic organics sorbed onto soil particles. Surfactants improve the effectiveness of contaminant removal by improving both the detergent properties of aqueous solutions and the efficiency by which organics may be transported by aqueous solutions. Surfactant washing is among the most promising of the in-situ chemical treatment methods.

Numerous environmentally safe and relatively inexpensive surfactants are commercially available. Use of surfactants to date has been restricted to laboratory research. Most of the research has been performed by the petroleum industry for tertiary oil recovery. Aqueous surfactants have also been proposed for gasoline cleanup. In a study performed by the Texas Research Institute for the American Petroleum institute, a mixture of an anionic and nonionic surfactants result in contaminant recovery of up to 40 percent. In a laboratory study conducted by Ellis and Payne, crude oil recovery was increased from less than 1 percent to 86 percent, and PCB recovery was increased from less than 1 percent to 68 percent when soil columns were flushed with an aqueous surfactant solution.

- o Immobilization (see in-situ containment)
- o Detoxification

Detoxification techniques are treatments that destroy, degrade, or otherwise reduce the toxicity of contaminants. The techniques include neutralization, hydrolysis, oxidation/reduction, enzymatic degradation, and permeable treatment beds. The techniques are applicable to specific chemical contaminants, therefore, uses of these in-situ techniques at waste sites will be limited.

Neutralization involves injecting dilute acids or bases into the groundwater to adjust the pH. This pH adjustment can serve as pretreatment prior to in-situ biodegradation, oxidation, or reduction. It can be used to neutralize acidic or basic plumes that need no other treatment, or to neutralize groundwater following another treatment. It an also be used during oxidation, reduction, or precipitation to prevent the formation of toxic gases including hydrogen sulfide and hydrogen cyanide.

The pH adjustment can also be used to increase the hydrolysis rate of certain organics. The rate of hydrolysis an be increased up to one order of magnitude for a change of one standard unit in pH. Classes of compounds with potential for in-situ degradation by hydrolysis include: esters, amides, carbamates, phosphoric and phosphonic acid esters, and pesticides. Because a hydrolysis product may be more toxic than the present compound, the pathways for reactions must be determined to ensure toxic products are not produced. A collection system should be incorporated as a fail safe measure with this technique to prevent migration of the treatment reagents and any contaminants which are not successfully treated.

Oxidation and reduction reactions serve to alter the oxidation state of a compound through loss or gain of electrons, respectively. Such reactions can detoxify, precipitate, or solubilize metals, and decompose, detoxify, or solubilize organics. Oxidation may render organics more amenable to biological degradation. Oxidation/reduction techniques are standard wastewater treatment approaches, but their application as in-situ treatment technologies is conceptual.

Oxidation of inorganics in soils, is for all practical purposes limited to oxidation of arsenic and possibly some lead compounds. The in-situ oxidation of arsenic compounds with potassium permanganate has been used to successfully reduce the arsenic concentrations in groundwater in Germany. Three oxidizing agents, of the large number that are available, have been considered potentially useful in the in-situ detoxification of organics in groundwater and soil: hydrogen peroxide, ozone, and hypochlorites. Each can react with a broad range of organics and could potentially oxidize a number of different organic contaminants in a hazardous waste site. Selection of the appropriate oxidizing agent is dependent in part upon the substance or substances to be detoxified, but also upon feasibility of delivery and environmental safety. Although there are some compounds that will not react with hydrogen peroxide but will react with ozone or hypochlorite, hydrogen peroxide appears to be the most feasible for in-situ treatment.

Ozone gas is a very strong oxidizing agent that is very unstable and extremely reactive. It cannot be shipped or stored; therefore, it must be generated on-site. Ozone rapidly decomposes and its half-life in groundwater is only 18 minutes. Ozone is used in the treatment of drinking water, municipal wastewater, and industrial waste, but has never been used in the treatment of contaminated soils or groundwater.

Hypochlorite, generally available as potassium, calcium, or sodium hypochlorite (bleach) is also used in the treatment of drinking water, municipal wastewater, and industrial waste. Hypochlorites have never been used in the treatment of contaminated groundwater or soils. The reaction of many organics with hypochlorite results in the formation of chlorinated organics which can be as more toxic than the original contaminant. The formation of lower molecular weight chlorinated organics in drinking water form hypochlorite treatment for disinfection purposes has become a major concern of the drinking water industry.

Hydrogen peroxide, a moderate strength chemical oxidant, is used routinely in municipal wastewater treatment to control various factors of biological treatment, and is also used in industrial waste treatment to detoxify cyanide and various organic pollutants. Hydrogen peroxide is commercially available in aqueous solutions of several concentrations and is miscible in water at all concentrations. It has been delivered successfully in dilute solutions to the subsurface as an oxygen source in a bioreclamation project.

Chemical reduction does not appear to be as promising as oxidation for the treatment of organics. Its effectiveness in soils has not been demonstrated. Chemical reduction does, however, appear promising for treatment of chromium and selenium in soils. The in-situ reduction of hexavalent to divalent chromium has been accomplished in Arizona well water using minute quantities of reducing agent.

There are a number of disadvantages with the use of oxidizing and reducing agents which limit their use at hazardous waste sites. The treatment compounds are non-specific and this may result in degradation of non-targeted compounds. There is a potential, particularly with oxidation, for the formation of more toxic or more mobile degradation products. Also, the introduction of these chemicals into the groundwater system may create a pollution problem in itself.

Enzymatic degradation of organics with cell-free enzymes holds potential as a possible in-situ treatment technique. Purified enzyme extracts, harvested from microbial cells, are commonly used in industry to catalyze a variety of reactions, including the degradation of carbohydrates and proteins. A bacterial enzyme preparation has been used to detoxify organophosphate waste from containers. Parathion hydrolase has been tested under field conditions in the degradation of the pesticide diazinon and has been found to effectively reduce concentrations in soil.

Permeable treatment beds are essentially excavated trenches placed perpendicular to groundwater flow and filled with an appropriate material to treat the plume as it flows through the material. Some of the materials that may be used in the treatment bed are limestone, crushed shell, activated carbon, glauconitic green sands, and synthetic ion exchange resins. Permeable treatment beds have the potential to reduce the quantities of contaminants present in leachate plumes. The system is applicable to relatively shallow groundwater tables containing a plume. To date, the application of permeable treatment beds at hazardous waste sites has not been performed.

Physical In-situ Methods

A number of methods are currently being developed which involve physical manipulation of the subsurface in order to immobilize or detoxify waste constituents. These technologies, which include in-situ heating, vitrification and ground-freezing, are in the early stages of development and detailed information is not available.

o Heating

In-situ heating has been proposed as a method to destroy or remove organic contaminants in the subsurface through thermal decomposition, vaporization, and distillation. Methods recommended for in-situ heating are steam injection and radio frequency heating.

The radio frequency heating process has been under development since the 1970s. Field experiments have been conducted for the recovery of hydrocarbons. The method involves laying a row of horizontal conductors on the surface of a landfill and exciting them with an RF generator through a matching network. The decontamination is accomplished in a temperature range of 300 to 400 degrees centigrade, assisted with steam, and requires a residence time of about two weeks. A gas or vapor recovery system is required on the surface. Excavation, mining, drilling, or boring is not required. This method appears very promising for certain situations involving contamination with organics, although more research is necessary.

o Freezing

Artificial ground freezing involves the installation of freezing loops in the ground and a self-contained refrigeration system that pumps coolant around the freezing loop. Although never used in an actual waste contaminant operation, the technology is being used increasingly as a construction method in civil engineering projects. Artificial ground freezing is done not on the waste itself, which may have a freezing point much lower than that of the soil systems, but on the soil surrounding the hazardous waste. It renders the soil practically impermeable, but is useful only as a temporary treatment approach because of the thermal maintenance expense.

o Vitrification (In-situ)

See discussion in-situ containment technologies.

Soil Washing

Soil washing is a process whereby excavated contaminated soil is washed with water to remove the contamination from the soil grains into the washwater. Chemical agents such as surfactants or chelants can be added to the washwater to increase the efficiency of contaminant removal. There is little or no actual experience with washing of excavated soil at hazardous waste sites in the United States. A few projects in the planning stages are reported. The soil-washing process has been used in several installations in Holland and West Germany. The process has been the subject of a U.S. EPA research program since about 1982, and at least one private firm (ECOVA) in the U.S. is attempting to market the process. In Europe soil-washing facilities are reported in Germany and the Netherlands.

The soil washing process consists of the following steps. First, the soil feed is screened to remove debris. The soil is then mixed with washwater in measured proportions. It is washed or scrubbed to obtain intensive contact between the soil grains and the washwater. Energy may be introduced into the mixture by high-pressure water jets, vibration devices, and/or other means. Next the washed soil is separated out of the washwater. Coarse soil particles can be separated in a trammel or vibrating screen device; finer sand separated in a sedimentation tank; and silt in a hydrocyclone or centrifuge device. The resulting fine soil and contaminated water mixture must then be treated for final disposal of solids and recycling of the water.

Soil-washing works successfully to clean coarse-grained soils of a wide range of organic and inorganic contaminants. It removes most water-soluble volatile organics and other highly mobile hydrophilic compounds from soil. The soil-washing process has great difficulty removing from fine-grained soils those organics and inorganic compounds which do not readily separate from the soil to water. There is a minimum soil grain size below which soil-washing cannot effectively remove metals and most nonvolatile and semivolatile organics. The addition of chelants and surfactants will somewhat reduce the minimum soil grain size which can be successfully cleaned. The addition of the chemicals to the washwater complicates the later treatment of the washwater for recycle or disposal.

Despite the lack of U.S. experience and limited European experience with soil-washing there is nothing to imply reliability problems. The equipment used for soil-washing is similar to equipment routinely used in the sand, gravel, and ore-processing industry. Good reliability is likely the soil-washing equipment is designed for the site soil and if properly maintained.

Thermal Destruction

Thermal destruction is a treatment method which uses high temperature oxidation under controlled conditions to degrade a substance into products that generally include carbon dioxide, water vapor, sulfur dioxide, nitrogen oxides, hydrogen chloride gas and ash. The hazardous products of the thermal destruction/incineration include all the previously mentioned products expect carbon dioxide and water vapor, plus incomplete products of combustion and they require air pollution equipment to control their release. Thermal destruction methods can be used to destroy organic contaminants in liquid, gaseous and solid waste streams. The most common incineration technologies applicable to hazardous waste sites are rotary kiln, multiple hearth, fluidized bed and liquid incineration. Advanced incineration technologies include molten salt, wet air oxidation, plasma arc torch, circulating bed, high temperature fluid wall, pyrolysis, supercritical water, electric tube reactor and vertical tube reactor. Many of these advanced technologies show promise and have been demonstrated to varying degrees, with a wide range of applicabilities, limitations and reliabilities. They are not presented here for conciseness and to allow focus on the most significant incineration technologies. However, they are well documented in the literature and should be evaluated if thermal treatment is included in the remedial action.

o Rotary Kiln

Rotary kilns are capable of handling a wide variety of solid and liquid wastes. They are cylindrical, refractory-line shells that are fueled by natural gas, oil, or pulverized coal. Most of the heating of the waste is due to heat transfer with the combustion product gases and the walls of the kiln. The basic type of rotary kiln incinerator, consists of a kiln and an afterburner.

Wastes are injected into the kiln at the higher end and are passed through the combustion zone as the kiln rotates. The rotation creates turbulence and improves combustion. Rotary kilns often employ afterburners to ensure complete combustion. Most rotary kilns are equipped with a wet scrubber for acid gas and possibly particulate emission control.

Rotary kilns are capable of burning wastes in any physical form. They can incinerate solids and liquids independently or in combination and can accept waste feed without any preparation. Wastes that have been treated in rotary kilns include PCBs, tars, obsolete munitions, polyvinyl chloride, and bottoms from solvent reclamation operations. Because of their ability to handle waste in any physical form, and their high incineration efficiency, rotary kilns are the preferred method for treating mixed hazardous solid residues.

Rotary kilns are susceptible to thermal shock, which necessitates very careful maintenance. The need additional air due to leakage, have high particulate loadings, relatively low thermal efficiency and a high capital cost.

o Multiple Hearth

Multiple hearth incinerators consist of a refractory lined steel shell, a rotating central shaft, a series of solid flat hearths, a series of rabble arms with teeth for each hearth, an air blower, waste feeding and ash removal systems, and fuel burners mounted on the walls. They also have an afterburner and can have liquid waste burners, and side ports for tar injections.

The multiple hearth incinerator an be used for the disposal of all forms of combustible materials, including sludges, tars, solids, liquid and gases. The incinerator is best suited for sludge destruction. Solid waste often requires pretreatment such as shredding and sorting. It can treat the same wastes as the rotary kiln provided that solids are pretreated. The principal advantages of multiple hearth incineration include high residence time for sludge and low volatile materials; the ability to handle a variety of sludges; the ability to evaporate large amounts of water; high fuel efficiency and the utilization of a variety of fuels.

Multiple hearth units are susceptible to thermal shock. They are unable to handle wastes that produce and ash which fuses into large rock-like structures and wastes requiring very high temperatures. Control of the firing of supplemental fuels in difficult. This type of incinerator has high maintenance and operating costs.

o Fluidized Bed

Fluidized bed incinerators consist of a cylindrical vertical refractory lined vessel containing a bed of inert granular material, usually sand on a perforated metal plate. Combustion air is introduced through a plenum at the bottom of the incinerator and rises vertically fluidizing the bed and maintaining turbulent mixing of bed particles. Waste material is injected into the bed and combustion occurs within the bubbling bed. Heat is transferred from the bed into the injected wastes. Auxiliary fuel is usually injected into the bed. Since the mass of the heated, turbulent bed is much greater than the mass of the waste, heat is rapidly transferred to the waste materials; a residence time of a few seconds for gases and a few minutes for liquids is sufficient for combustion.

The most typical wastes being treated in fluidized beds include slurries and sludges. Some waste require pretreatment such as drying, shredding and sorting. The fluidized bed can handle the same wastes as the rotary kiln. They have been used for the disposal of municipal wastewater treatment sludges, oil refinery waste, and pulp and paper mill waste. There is only limited data on the use of this technology for hazardous waste incineration. It has been used for phenolic wastes and methyl methacrylate. It is particularly well suited for high-moisture wastes, sludges, and wastes containing large quantities of ash.

The advantages of fluidized bed incineration include simple design, minimal NOx formation, long life of the incinerator, high efficiency and simplicity of operation. It has the ability to trap some gases in the bed, reducing the need for an emission control system. The disadvantages included difficulty in removing residual materials from the bed, a relatively low throughput capacity, and the difficulty of handling residues and ash from the bed costs.

o Liquid Injection

A liquid incineration system consists of a single or double refractory-line combustion chamber and a series of atomizing nozzles. Two chamber systems are more common. The primary chamber is usually a burner where combustible liquid and gaseous wastes are introduced. Noncombustible liquid and gaseous wastes are introduced downstream of the burner in the secondary chamber.

Liquid injection can be used to destroy virtually any pumpable waste. If viscosity precludes atomization, mixing and heating can be used to prior to atomization. These units have been used in the destruction of PCBs, solvents, still and reactor bottoms, polymer wastes, and pesticides. Unlikely candidates for destruction include heavy metal wastes and wastes high in inorganics.

Liquid incinerators have no moving parts and require the least maintenance of all types of incinerators. The major limitations of these units are its ability to incinerate only wastes which can be atomized in the burner nozzle and the burner's susceptibility to clogging. It also needs supplemental fuel. Liquid injection incinerators are highly sensitive to waste composition and flow changes. Storage and mixing tanks are usually required to ensure a reasonably steady and homogenous waste flow.

Excavation Technologies (contaminated soil only)

Excavation and removal followed by land disposal or treatment are performed extensively in hazardous waste site remediation. There are no absolute limitations on the types of waste which can be excavated and removed. However, worker health and safety weighs heavily in the decision to excavate explosive, reactive, or highly toxic waste material. Other factors which are considered include the mobility of the wastes, the feasibility of on-site containment of in-situ treatment and the cost of disposing the waste or rendering it non-hazardous once it has been excavated. A frequent practice at hazardous waste sites is to excavate and remove contaminant "hot spots" and to use other remedial measures for less contaminated soils. Excavation and removal is applicable to almost all site conditions, although it may become cost-prohibitive at great depths or in complex hydrogeologic environments.

The nature and extent of preventative and mitigative measures required for controlling environmental releases during excavation and removal are site specific, although there are a number of general procedures that apply to all sites. Operating areas for staging and treating drummed wastes and contaminated soils should at a minimum be graded to prevent puddling; lined with polyethylene or clay; and bermed or diked. Where temporary impoundments must be used to store liquids, it may be acceptable to provide a thick clay liner and to excavate the contaminated soils after use of the impoundment is completed.

As soils are being excavated on-site, air monitoring should be conducted to determine unsafe levels of various constituents in the ambient air. Numerous portable direct reading instruments are available. As contaminated soils are excavated from the disposal area, they should be transferred to box truck or to a temporary storage area, preferably a diked or bermed area lined with plastic or low permeability clay. A layer of absorbent material should be placed on the bottom of the temporary storage area.

Excavation and removal can almost totally eliminate the contamination at a site and the need for long-term monitoring. Once excavation is begun, the time to achieve beneficial results can be short relative to alternative technologies. Excavation and removal can be used in combination with almost any other remedial technologies.

The greatest problems with excavation, removal, and off-site disposal are associated with worker safety, short term impacts, cost, and institutional aspects. Where highly hazardous materials are present, excavation can pose a substantial risk to worker safety. Short term impacts such as fugitive dust emissions, toxic gases, and contaminated run-off are frequently a major concern, although mitigation measures can be taken. The location of the nearest RCRA-approved landfill or incinerator is a very important consideration.

The excavation technologies include loading and casting excavation, hauling excavation, pumping and industrial vacuum loaders. The excavation technologies use equipment that is well known and demonstrated.

Pumping may be required in order to remove liquids and sludges from waste sites. The liquid wastes may be pumped to a treatment system or a tank truck for transport off-site. The selection of a pump is complicated by the presence of chemicals that could corrode or dissolve pump parts. Corrosive liquids having a low pH or a high chloride ion content can rapidly destroy most metal pumps. Wetted parts should be plastic, rubber, or ceramic, or if made of iron, should be alloyed with silicon and/or chromium. It is extremely important to check the chemical compatibility of seals with the fluid being pumped.

The presence of abrasive liquids also influences pump selection. Internal passages must have adequate dimensions or abrasive particles will damage parts that they rub against. Close internal clearances between stationary and moving parts is undesirable. Rubber and ceramic parts resist abrasive wear better than metal parts. Many manufacturers make abrasion-resistant models, and the pump should be selected after a detailed assessment of the waste to be pumped.

Industrial vacuum loaders such as the "Supersucker" can be used in large scale cleanup operations to remove soil or pools of liquid waste. Using industrial loaders for soil removal is safer and more efficient than using hand tools. The typical equipment consists of a vehicle mounted high-strength vacuums that can carry solids, liquids, metal and plastic scraps, and almost any other material that can fit through the hose (i.e., 7 inch). Because of the large capacity of the vacuum cylinder, vacuum trucks are generally not well suited volume to be removed less than the equivalent of 30 drums.

An important consideration with vacuum loaders is the compatibility of wastes with materials of construction. Vacuum cylinders can be purchased in carbon steel, stainless steel, aluminum, and nickel. They can be treated with a variety of coatings including epoxy, fiberglass, and neoprene rubber.

Disposal Technologies (contaminated soil only)

This section describes the major factors to consider in the selection of an off-site or on-site disposal facility. Disposal technologies are landfilling and incineration. Landfilling of hazardous materials is becoming difficult and more expensive due to steadily growing regulatory control. Wastes that are amenable to treatment or incineration should be segregated from wastes for which no treatment alternative is known. Landfilling should usually be regarded as the least attractive alternative at a site cleanup.

o Off-site Disposal

Determining the feasibility of off-site disposal by landfilling, incineration or both requires knowledge of RCRA regulations (40 CFR Parts 261-265) and other regulations developed by states. RCRA manifest requirements must be complied with for all wastes that are shipped off-site. In addition, the waste generator must comply with RCRA manifest requirements. The generator should ensure that the facility selected to receive the wastes is in compliance with all applicable Federal and State regulations. RCRA storage and disposal facilities are required to notify the generator, in writing, that they are capable of managing the wastes. The generator must keep a copy of this written notification on file as part of the operating record.

A detailed waste analysis is generally required before a waste is accepted by a treatment/disposal facility. On-site pretreatment of wastes may be required in order to make them acceptable for off-site transport or to meet the requirements of an incineration or disposal facility.

The transportation of wastes is regulated by the Department of Transportation (DOT), the EPA, the States, and in some instances local regulations. The EPA regulations under RCRA adopt DOT regulations pertaining to labeling, placarding, packaging, and spill reporting. Vehicles for off-site transport must be DOT approved and must display the proper DOT placard. Before a vehicle is allowed to leave the site, it should be rinsed or scrubbed.

- On-site Land Disposal

On-site disposal landfilling.

The on-site disposal of wastes by landfilling will require the design and construction of new landfills which comply substantially with RCRA landfill facility standards under 40 CFR Part 264. It should be noted that EPA guidance for CERCLA responses require most on-site disposal actions "to attain or exceed applicable and relevant standards of Federal public health and environmental laws, unless specific circumstances" dictate otherwise.

The RCRA requirements under 40 CFR Part 264 and all associated guidance are concerned with the proper location, design, construction, operation, and maintenance of hazardous waste management facilities. These requirements preclude landfilling in areas of seismic instability, in a 100-year floodplain, and where the integrity of the liner system would be adversely affected. These requirements also preclude landfilling of liquids and several types of highly mobile and/or highly toxic wastes. In addition to complying with these requirements, the evaluation of an on-site landfill program must address potential risks posed by the depth to groundwater at the site and the degree of naturally available groundwater protection if the liner system should fail. Other factors entering this evaluation include costs for monitoring the groundwater, collecting any accumulated leachate, and for implementing further corrective action if the groundwater has been contaminated by a leak from the new landfill.

The operating life of an on-site landfill should be minimized to avoid unnecessary generation of leachate caused by rainfall into an open cell. Sometimes it is more efficient to construct several landfill cells in sequence rather than to construct on large cell which will remain open for a long time period. All materials placed into a landfill should be compacted as much as possible using heavy equipment. This practice will minimize settling after closure. All equipment operators and workers must be thoroughly trained.

RCRA requires all land disposal facilities to establish a groundwater monitoring program. The program must be capable of determining the facility's impact on the quality of groundwater in the uppermost aquifer underlying the facility.

On-site landfilling is an expensive technology which should only be considered when: (1) there is so much waste to be disposed that the total cost of off-site waste management at an acceptable site is comparable; (2) simple capping of the site will not provide adequate protection of human health and the environment; and (3) on-site conditions will allow the construction of a landfill that will protect human health and the environment. Since it is rare that all three of the above conditions are met at a site, the on-site landfill option is not frequently used.

Migration Control

Technologies that will eliminate, reduce or modify the migration of the liquid plume or vapors in the ground or fugitive dust at the surface.

Containment and Diversion Technologies (of migration)

Surface water controls include a wide range of containment, diversion and collection methods which are designed to minimize contamination of surface waters, prevent surface water infiltration, and prevent off-side transport of surface waters which have been contaminated. The commonly employed technologies are capping, floating Covers, grading, revegetation, and surface water diversion/collection. The most effective strategy for managing surface flow frequently includes a combination of several of these water control technologies.

o Capping

Capping is a process used to cover buried waste materials to prevent their contact with the land surface and groundwater. The designs of modern caps usually conform to the performance standards in 40 CFR 264.310, which addresses RCRA landfill closure requirements. These standards include minimum liquid migration through the wastes, low cover maintenance requirements, efficient site drainage, high resistance to damage by settling or subsidence, and a permeability lower than or equal to the underlying liner system or natural soils. These performance standards may not always be appropriate, particularly in instances where the cap is intended to be temporary, where there is very low precipitation, and when the capped waste is not leached by infiltrating rainwater.

There are a variety of cap designs and capping materials available. Most cap designs are multi-layered to conform with design standards, however, single-layered designs are also used for special purposes. The selection of capping materials land a cap design is influenced by specific factors such as local availability and costs of cover materials, desired functions of cover materials, the nature of the wastes being covered, local climate and hydrogeology, and projected future use of the site in question.

Capping is necessary whenever contaminated materials are to be buried or left in place at a site. In general, capping is performed when extensive subsurface contamination at a site precludes excavation and removal of wastes. Capping is performed together with the groundwater extraction or containment technologies to prevent or significantly reduce further plume development. Ground waster monitoring wells are often use in conjunction with caps to detect any unexpected migration off the capped wastes. A gas collection system should always be incorporated into a cap when wastes may generate gases. Capping is also associated with surface waster control technologies such as ditches, dikes and berms because these structures are often designed to accept rainwater drainage from the cap. Grading and revegetation are incorporated into multi-layered caps.

Caps need long-term maintenance and have uncertain design lives. Caps will need to be periodically inspected for settlement, ponding of liquids, erosion, and naturally occurring invasion by deep-rooted vegetation. Groundwater monitoring wells associated with caps need to be periodically sampled and maintained.

Caps generally have a minimum design life of 20 years when a synthetic liner is the only liquid barrier. This period may extend to over one hundred years when a synthetic liner is supported by a low-permeability base; the underlying wastes are unsaturated; there is great distance between the waste and the groundwater table; and proper maintenance procedures are observed.

Multi-layered caps generally conform to EPA's guidance under RCRA which recommends a Three-layered system consisting of an upper vegetative layer, underlain by a drainage layer over a low permeability layer. The vegetative layer is served by the topsoil layer; the drainage layer can be composed of sand; and the low permeability layer can be formed by a combined synthetic and soil liner system. The cap functions by diverting infiltrating liquids from the vegetative layer through the drainage layer and away from the underlying waste materials.

The low permeability layer of the multi-layered cap can be composed of natural soils, admixed soils, a synthetic liner overlying at least 2 feet of low permeability natural soil or soil admix is recommended because the synthetic liner allows virtually no liquid penetration for a minimum of 20 years, while the soil layer provides assurance of continued protection even if the synthetic liner fails.

Standard design practices specify permeabilities of less than 1- E-7 cn/sec for the soil liner. This specification could be met with a natural soil or blending of different on-site soils. Chemical stabilizers, cements, lime, ash, furnace slag or other materials may be added to soil to modify its properties.

Flexible synthetic membranes are made of polyvinyl chloride, chlorinated polyethylene, ethylene propylene rubber, butyl rubber, Hypalon and neoprene, and elasticized polyolefin can be used as liners. Synthetic liners are generally more expensive and involve labor-intensive sealing materials that require special field installation methods.

Single-layered caps can be constructed of any of the low permeability materials mentioned previously. Natural soil and admixes are not recommended because they are disrupted by freeze/thaw cycles and exposure to drying causes them to shrink and crack. The most effective single layer caps are composed of concrete and/or bituminous asphalt.

Capping is a reliable technology for sealing off contamination from the aboveground environment and significantly reducing underground migration of wastes. Caps can be constructed over virtually any site, and can be completed relatively quickly if the ground is not frozen or saturated. Most of the soil materials for capping are readily available in most areas of the country, and the synthetic materials are widely manufactured and distributed. The equipment used for implementing this technology is mostly standard road construction equipment, however some specialized testing equipment must be supplied by the liner installer or a soil testing company.

The performance of a properly installed, multi-layered cap is generally excellent for the first 20 years of service. However, after this time period the integrity of the synthetic liner becomes uncertain and should be investigated regularly. Unforseen settling invasions by burrowing animals and deep-rooted plants can contribute to the need for periodic monitoring and maintenance of the cap. Groundwater monitoring wells, often associated wit caps, need to be sampled periodically and maintained.

o floating Covers

Floating covers are mentioned to insure that all potential technologies are considered. This technology is not discussed in detail because the sources for which it is appropriate are not present. Floating cover consist of a synthetic lining placed in one piece over an impoundment, with proper anchoring at the edges, and with floats to prevent the lining from submerging. This technology is used mainly to cover drinking water supply reservoirs, but it can be used temporarily to prevent overtopping a waste lagoon.

o Grading

Grading is the general term for techniques use to reshape the surface of covered landfills in order to manage surface water infiltration and run-off while controlling erosion. The spreading and compaction steps used in grading are techniques practiced routinely at sanitary landfills. The equipment and methods used in grading are essentially the same for all landfill surfaces, but applications of grading technology will vary by site. Grading is often performed in conjunction with surface sealing practices and revegetation as part of an integrated closure plan.

The techniques and equipment used in grading operations are well established and are widely used in all forms of land development. It is usually possible to find contractors and equipment locally, thus expediting the work and avoiding extra expenses.

Surface grading serves to (1) reduce ponding which minimizes infiltration and reduces subsequent differential settling, (2) reduces runoff velocities to reduce soil erosion, (3) roughens and loosens soils in preparation for revegetation and (4) can be a factor in reducing or limiting leaching of wastes.

There are potential difficulties associated with grading. Large quantities of a difficult to obtain cover soil may be required to modify existing slopes. Periodic regrading and future site maintenance may be necessary to eliminate depressions formed through differential settlement and compaction, or to repair slopes that have slumped or become badly eroded.

o Revegetation

Revegetation is the establishment of a vegetative cover as a method to stabilize the surface of a disposal site. This technique is often preceded by capping and grading. Revegetation decreases erosion by wind and water and contributes to the development of a naturally fertile and stable surface environment. Revegetation includes (1) selection of plant species, (2) seedbed preparation, (3) seeding/planting, (4) mulching and/or chemical stabilization, and (5) fertilization and maintenance.

There are potential problems implementing a revegetation program. Clays or synthetic barriers below support topsoil in poorly drained areas may cause swamping of cover soil and subsequent anaerobic conditions. A cover soil which is too thin may dry excessively in arid seasons and irrigation may be necessary. Improperly vented gases and soluble phytotoxic contaminants may kill or damage vegetation. The roots of shrubs or trees may penetrate the waste cover and cause water infiltration and gas exfiltration. Periodic maintenance of revegetated areas may include liming, fertilizing, mowing and/or replanting.

A well-designed and properly implemented revegetation plan will effectively reduce erosion and stabilize the surface of a covered disposal site, thereby improving the effectiveness and reliability of the cap. A multi-layered capping system and properly graded slopes, in combination with suitable vegetative cover, will eventually isolate buried wastes from surface hydrologic input.

Although vegetative covers requires frequent maintenance, it actually prevents more costly maintenance which would result form erosion by surface soils. Revegetation is also essential to the integrity and performance of dikes, waterways, and sedimentation basins.

o Surface Water Diversion and Collection

Surface water diversion and collection technologies include dikes, berms, channels, waterways, terraces, benches, chutes, downpipes, seepage basins, ditches, sedimentation basins and ponds, levees and floodwalls. All these technologies are well-established. Many of these are intended for short-term use and are neither effective nor reliable for use as a long-term remedial measure.

Dikes and berms are well-compacted earthen ridges or ledges constructed immediately upslope from or along the perimeter of disturbed areas. These structures are generally designed to provide short-term protection of critical areas by intercepting storm run-off and diverting the flow to natural or manmade drainage ways, to stabilized outlets, or to sediment traps.

Dikes and berms ideally are constructed of erosion-resistant, low permeability, clay soils. The general design life of these structures is on the order of lone year maximum;

seeding and mulching or chemical stabilization of dikes and berms may extend their life expectancy.

Channels are excavated ditches. Diversion channels are used primarily to intercept run-off or reduce slope length. They may be stabilized with vegetation or stone rip-rap.

Failure of channels and waterways may result from insufficient capacity, excessive velocity, or inadequate vegetative cover. Grassed waterways must be periodically mowed to prevent excessive retardation of flow and subsequent ponding of water. Vegetated channels may also require periodic sodding, remulching, and fertilizing. Sediment accumulation often results in failure of channels and waterways. Control of vegetation to prevent matted growth and high allowable design velocities will reduce sediment accumulation. Stone channels have the advantage of requiring minimum maintenance.

Terraces and benches are embankments constructed along the contour of very long or very steep slopes to intercept and divert flow and to control erosion by reducing slope length. These structures are classified as bench terraces or drainage benches. Bench terraces are used primarily to reduce land slope while drainage benches on broadbased terraces act to remove or retain water on sloping land.

Chutes and downpipes are structures used to carry concentrated flows of surface run-off from one level to a lower level without erosive damage. They generally extend downslope from earthen embankments and convey water to stabilized outlets located at the base of terraced slopes. Chutes are open channels, normally lined with bituminous concrete, portland cement concrete, grouted rip-rap, or similar non-erodible material. Downpipes are temporary structures constructed of rigid piping or flexible tubing of heavy-duty fabric.

Chutes and downpipes often represent key elements in combined surface control systems. They are especially effective in preventing erosion on long, steep slopes, and can be used to channel storm run-off to sediment traps, drainage basins, or stabilized waterways for off-site transport. However, they provide only temporary erosion control while slopes are stabilized with vegetative growth.

Seepage basins and ditches are used to discharge water to groundwater. They may also be used in in-situ treatment to force reagents into the subsurface. Seepage basins and ditches are most effective in highly permeable soils so that recharge can be performed. They are not applicable at sites where collected run-off or groundwater is contaminated. Many basins and ditches are used in areas with shallow groundwater tables. Very deep basins or trenches can be hazardous. Seepage ditches distribute water over a larger area than achievable with basins. They can be used for all soil where permeability exceeds about 0.9 inches per day. It is unlikely that this technology would be appropriate for the INEL site because of the deep groundwater table and uncertainties associated with the vertical flow of liquids.

Sedimentation basins are used to control suspended solids entrained in surface flows. A sedimentation basin is constructed by placing an earthen dam across a water or natural depression, or y excavation, or by a combination of both. The purpose of installing a sedimentation basin is to impede surface run-off carrying solids, thus allowing sufficient time for the particulate mater to settle. Sedimentation basins are usually the final step in control of diverted, uncontaminated, surface run-off, prior to discharge. They are especially useful in areas where there exists a high silt or sand content in the surface run-off.

Levees are earthen embankments that function as flood protection structures in areas subject to inundation from tidal flow or riverine flooding. Levees create a barrier to confine floodwaters to a floodway and to protect structures behind the barrier. Floodwalls perform much the same function as levees, but are constructed of concrete. For hazardous waste sites, levees and floodwalls help to control major losses of waste and cover material and prevent massive leachate production and subsequent contamination from riverine or tidal flooding.

Flood containment levees are most suitable for installation in flood fringe areas or areas subject to storm tide flooding, but not for areas directly within open floodways. Because of the relatively long, flat side slopes of levees, an embankment of any considerable height requires a very large base width. For locations with limited space and fill material, or excessive real estate costs, the use of concrete floodwalls is preferred as an alternative to levee construction.

Levees are generally constructed of compacted impervious fill. Special drainage structures are often required to drain the area behind the embankment. Ideal construction of levees is with erosion-resistant low permeability soils, preferably clay. Most levees are homogeneous embankments; but if impermeable fill is lacking, or if seepage through and below the levee is a problem, then construction of a compacted impervious core or sheet-pile cut-off extending below the levee to bedrock may be necessary.

All the diversion and containment methods described require frequent inspection, maintenance, performance checks to ensure continuous reliability. Operation and maintenance requirements for these measures are relatively simple. However, failure of such surface control measures as floodwalls can be costly.

Groundwater Control

Control of contamination in the groundwater involves one of four options: (1) containment of a plume; (2) removal of a plume after measures have been taken to halt the source of contamination; (3) diversion of groundwaters to prevent clean groundwater from contacting a drinking water supply; or (4) prevention of leachate formation by lowering the water table beneath a source of contamination. Remedial technologies for controlling groundwater contamination problems are generally placed in one of four categories: (1) groundwater pumping, involving extraction of water from or injection of water into wells to capture a plume or alter the direction of groundwater movement; (2) subsurface drains, consisting of gravity collection systems designed to intercept groundwater; (3) low permeability barriers, consisting of a vertical wall of low permeability materials constructed underground to divert groundwater flow or minimize leachate generation and plume movement; or (4) in-situ treatment methods to biologically or chemically remove or attenuate contaminants in the subsurface. These technologies can be used singularly or in combination to control groundwater contamination. This section describes these technologies. The 600 foot depth to the groundwater table and the overlying basalt layers would make the implementation of some groundwater controls such a drains and barriers difficult, cost prohibitive and probably technically infeasible. However, they are presented in this section with limited detail to insure that all technologies are considered.

o Groundwater Pumping

Groundwater pumping techniques involve the active manipulation and management of groundwater in order to contain or remove a plume or to adjust groundwater levels in order to prevent formation of a plume. Types of wells used in management of contaminated groundwater include wellpoints, suction wells, ejector wells, and deep wells. The selection of the appropriate well type depends upon the depth of contamination and the hydrologic and geologic characteristics of the aquifer.

Pumping is most effective at sites where underlying aquifers have high intergranular hydraulic conductivity. It has been used with some effectiveness at sites with moderate hydraulic conductivities and where pollutant movement is occurring along fractured or jointed bedrock. In fractured bedrock, the fracture patterns must be traced in detail to ensure proper well placement.

Where plume containment or removal is the objective, either extraction wells or a combination of extraction and injection wells can be used. Use of extraction wells alone is best suited to situations where contaminants are miscible and move readily with water; where the hydraulic gradient is steep and hydraulic conductivity high; and where quick removal is not necessary. Extraction wells are frequently used in combination with slurry walls to prevent groundwater from overtopping the wall and to minimize contact of the leachate with the wall in order to prevent wall degradation.

A combination of extraction and injection wells is frequently used in containment or removal where the hydraulic gradient is relatively flat and hydraulic conductivities are only moderate. The function of the injection well is to direct contaminants to the extraction wells. This method has been used with some success for plumes which are not miscible with water. One problem with such an arrangement of wells is that, dead spots can occur when these configurations are between adjacent radii of influence. Another disadvantage is that injection wells can suffer from many operational problems, including air locks and the need for frequent maintenance.

Ground water barriers can be created using injection wells to change both the direction of a plume and the speed of plume migration. By crating an area with a higher hydraulic head, the plume can be forced to change direction. This technique may be desirable when short-term diversions are needed or when diversion will provide the plume with sufficient time to naturally degrade so that containment and removal is not required.

Wellpoint systems are effective in almost any hydraulic situation. They are best suited for shallow aquifers where extraction is not needed below more than about 22 feet. Beyond this depth, suction lifting is ineffective. Suction wells operate in a similar fashion to wellpoints and are also depth limited. The only advantage of suction wells over wellpoints is that they have higher capacities. For extraction depths greater than 20 feet, deep wells and ejector wells are use. Deep well systems are better suited to homogeneous aquifers with high hydraulic conductivities and where large volumes of water may be pumped. Ejector wells perform better than deep wells in heterogeneous aquifers with low hydraulic conductivities. A problem with ejector systems is that they are inefficient and are sensitive to constituents in the groundwater which may cause chemical precipitates and well clogging.

Ground water pumping systems are the most versatile and flexible of the groundwater control technologies. When used together with a barrier wall and cap, complete hydrologic isolation of a site can be achieved. Groundwater pumping systems, however, perform poorly in low transmissivity aquifers.

Operational flexibility is high since pumping rates can be modified to adjust to changes in flow rate. System performance is generally good provided the wells are properly designed and maintained. Deadspots and areas where cones of depression overlap should be continuously monitored to ensure effectiveness. The reliability of pumping systems can be adversely affected by mechanical and electrical failure of pumps which can result in loss of contaminants. However, repairs and replacement of parts can be done quickly and easily.

Well systems are generally safer to install then drains and barrier walls since there is no need for trench excavation. Installation is relatively easy and quick. Contractors qualified to drill and install wells are readily available.

o Subsurface drains

Subsurface drains include any type of buried conduit used to convey and collect aqueous discharges by gravity flow. Subsurface drains essentially function like an infinite line of extraction wells. They create a continuous zone of influence in which groundwater within this zone flows towards the drain.

Drains essentially function like an infinite line of extraction wells, they can perform many of the same functions as wells. They can be used to contain or remove a plume, or to lower the groundwater table to prevent contact of water with the waste material. The decision to use drains or pumping is generally based on cost-effectiveness.

For shallow contamination problems, drains can be more cost-effective than pumping, particularly in strata with low or variable hydraulic conductivity. Under these conditions, it would be difficult to design and it would be cost prohibitive to operate a pumping system to maintain a continuous hydraulic boundary. Subsurface drains may also be preferred over pumping where groundwater removal is required over a period of several years, because the operation and maintenance cost associated with pumping are substantially higher.

Subsurface drains are generally limited to shallow depth. Although it is technically feasible to excavate a trench to almost any depth, the costs of shoring, dewatering, and hardrock excavation can make drains cost prohibitive at depths of less than 40 feet. However, in stable low permeability soils where little or no rock excavation is required, draining may be cost-effective to depths of 100 feet. Other limitations to the use of this technology include the presence of viscous or reactive chemicals which could clog drains and envelope material. Conditions which favor the formation of iron manganese or calcium carbonate deposits may also limit the use of drains.

Relative to pumping, subsurface drains can be difficult and costly to install particularly where extensive hard rock excavation and dewatering is required. They are also time consuming to install and may not be an appropriate alternative where immediate remediation is required. Safety of field workers is also more of a concern with subsurface drains because of the need for extensive trench excavation.

Drains are generally more cost-effective than pumping in areas with low hydraulic conductivity particularly where pumping would be required for an extended period of time. They are easier to operate since water is collected by gravity flow. They are also more reliable from the standpoint that there are no electrical components which can fail. However, when drains fail due to clogging, breaks in the pipes, or sinkhole formation, they can be costly and time consuming to rehabilitate.

o Subsurface Barriers

Subsurface barriers are a variety of methods whereby low permeability cut-off walls or diversions are installed below ground to contain, capture, or redirect groundwater flow in the vicinity of a site. The most commonly use subsurface barriers are slurry walls, particularly soil-bentonite slurry walls. Less common are cement-bentonite or concrete (diaphragm) slurry walls, grouted barriers, and sheet piling cut-offs. Grouting may also be used to crate horizontal barriers for sealing the bottom of contaminating sites.

Slurry walls are the most common subsurface barriers because they are a relatively inexpensive means of vastly reducing groundwater flow in unconsolidated earth materials. The term slurry wall can be applied to a variety of barriers all having one thing in common; they are all constructed in a vertical trench that is excavated under a slurry. This slurry, usually a mixture of bentonite and water, acts essentially like a drilling fluid. It hydraulically shores the trench to prevent collapse, and, at the same time, forms a filter cake on the trench walls to prevent high fluid losses into the surrounding grounds. Slurry wall types are differentiated by the materials used to backfill the slurry trench. Most commonly, an engineered soil mixture used to backfill the slurry trench. Typically, and engineered soil mixture is blended with the bentonite slurry and placed in the trench to form a soil-bentonite slurry wall. In some cases, the trench is excavated under la slurry or portland cement, bentonite, and water, and this mixture is left in the trench to harden into a cement-bentonite slurry wall. In the rare case where great strength is required, pre-cast or cast-in-place concrete panels are constructed in the trench to form a diaphragm wall.

Soil-bentonite slurry walls are backfilled with soil materials mixed with a bentonite and water slurry. Of the three major types of slurry walls, soil-bentonite walls offer the lowest installation costs, the widest range of chemical compatibilities, and the lowest permeabilities. At the same time, soil-bentonite walls have the least strength and require a large work area, and, because the slurry and backfill can flow, are applicable only to sites that can be graded to nearly level. A major concern in the application of soil-bentonite walls to site remediation is the compatibility of the backfill mixture with site contaminants. Evidence indicates that soil-bentonite backfills are not able to withstand attack by strong acids and bases, strong salt solutions, and some organic chemicals. For contaminate migration control there is a lack of long-term performance data. Soil bentonite walls have been used for decades for groundwater control in conjunction with large dam projects and there is ample evidence of their success in this application. The ability to withstand long-term permeation by many contaminants is in question.

Cement-bentonite slurry walls share many characteristics with soil-bentonite slurry walls. The principal difference between the two is the backfill. They are generally excavated using a slurry of Portland cement, bentonite, and water. This slurry is left in the trench and allowed to set up to form the completed barrier.

Cement-bentonite walls are more versatile than soil-bentonite in two ways. First, because the slurry sets up into a semirigid solid, this type of wall can accommodate variations in topography by allowing one section to set while continuing the next section at a different elevation. Second, because the excavation slurry is commonly the backfill too, this type of wall is better suited to restricted areas where there is no room to mix soil-bentonite backfill. Cement-bentonite is stranger than soil-bentonite and so is used where the wall must have less elasticity, such as adjacent to a building or roads.

Cement-bentonite slurry walls are limited in their use by their higher costs, somewhat higher permeability, and their narrower range of chemical compatibilities. Cement-bentonite is susceptible to attack by sulfates, strong acids and bases, and other highly ionic substances.

Diaphragm walls are barriers composed of reinforced concrete panels, which are emplaced by slurry trenching techniques. They may be cast-in-place or precast, and are capable of supporting great loads. This degree of strength is seldom if ever called for at a waste site. This technology has the same limitations as cement-bentonite slurry walls.

Grout curtains are subsurface barriers created in unconsolidated materials by pressure injection. Grout barriers can be many times more costly as slurry walls and are generally incapable of attaining truly low permeabilities in unconsolidated materials. A recent field test study of two chemical grouts revealed significant problems in forming a continuous grout barrier due to non-coalescence of grout pods in adjacent holes and grout shrinkage. This study concludes that conventional injection grouting is incapable of forming a reliable barrier in medium sands. Grout curtains, while requiring no operation and little or no maintenance may require more monitoring than other barriers. This is because if even a very small gap is left in the barrier, it can enlarge quite rapidly by piping or tunneling if there is a sufficient hydraulic gradient across the wall.

Sheet Piling can be used to form a groundwater barrier. Sheet piles can be made of wood, pre-cast concrete, or steel. Wood is an ineffective water barrier, however, and concrete is used primarily where great strength is required. Steel is the most effective in terms of groundwater cut-off and cost. Steel is ineffective in rocky soils because damage or deflection of the piles is likely to render the wall ineffective.

The performance life of sheet piling wall can be between 7 and 40 years, depending on the condition of the soil in which the wall is installed. Sheet piling walls have been installed in various type of soils ranging from well-drained sand to imperious clay.

o In-situ Treatment

See earlier discussion on in-situ waste treatment.

<u>Fugitive Dust Controls</u>

Fugitive dust is particulate matter that becomes airborne due to the forces of wind, man's activity, or both. It may include windblown particulate matter from paved or unpaved roads, exposed land surface and/or material made airborne by vehicular movement. Commonly used techniques for controlling fugitive dusts from waste sites include the use of chemical dust suppressants, wind screens, water sprays and other measures. These are all techniques tat are proven and have been used widely.

o Dust Suppressant

Dust suppressants include a wide range of natural and synthetic waste materials which strengthen bonds between soil particles and hold this strengthened condition for an appreciable period of time. A wide variety of resins, bituminous materials and polymers are marketed as dust suppressants. Chemical dust suppressants are most commonly applied with water wagons equipped with muzzles that shoot a flat spray behind the vehicle. The effectiveness of a dust suppressant is dependent upon maintaining the soil-chemical crust. Emerging weeds and any type of disturbance from traffic will break this crust. This technology is an effective temporary control measure. It must be reapplied to provide long-term fugitive dust control. Application is straightforward and can be accomplished quickly. There is a potential for secondary impacts from the use of certain chemical dust suppressants which contain toxic substances.

o Wind Fences/Screens

A wind fence is a porous screen which takes up or deflects a sufficient amount of wind so that the wind velocity is lowered below the threshold required for initiation of soil movement. Wind screens are typically 4 to 10 feet high and are composed of polyester or other high strength material. This technology is only 60 percent efficient in controlling inhalable particulate at wind speeds of 10 to 13 mph. Studies have shown no consistent benefits from windscreens for particles in the respirable size range. Maximum reduction of wind velocity can be expected for a distance of 1 to 5 fence heights down stream.

o Water sprays

Water spray is the most common means of dust control. It simply involves spraying water on the exposed surface areas. This method is mainly used to reduce fugitive dusts along active travel paths, excavation areas and from tuck boxes loaded with soils. Active travel areas dry quickly and water must be reapplied frequently (about every 2 hours) to maintain effectiveness.

o Other measures

Other measures for paved roads include sweeping, vacuuming or flushing. These methods are not effective with fine particles. Dust from excavation activities can be reduced by maintaining a favorable slop and orientation on the waste or overburdened piles. Piles can also be covered and an auger feed system can be installed to emplace and remove material.

Gaseous Emissions Controls

Gases may be emitted by the vaporization of liquids, venting or entrained gases or by chemical and biological reactions with solid and liquid waste material. Volatile organics may be released slowly but continuously form surface impoundments or landfills. Methods for controlling the release of gaseous emissions to the atmosphere include covers for control of volatile emissions from impoundments and active gas collection systems for collection and control of gases generated in landfills.

o Covers

Covers involve the placement of a barrier at the water-air interface to reduce gaseous emissions. Lagoon covers, floating immiscible liquids and floating spheres can all be use for this purpose. There are no sources at the INEL site for which this remedial technology is appropriate. Therefore it is not presented in more detail.

o Passive Perimeter Gas Control Systems

Passive perimeter gas control systems control gas movement by altering the paths of flow without the use of mechanical components. Passive systems may be further categorized as high-permeability or low permeability.

High-permeability systems entail the installation of highly permeable trenches or wells between the landfill and the area to be protected. Since the permeable material offers conditions more conducive to gas slow than the surrounding soil, paths of flow to points of controlled release are established. High-permeability systems generally take the form of trenches or wells excavated outside of the landfill limit and backfilled with a highly permeable medium such as a course crushed stone.

Low-permeability systems effectively block gas flow into areas of concern by the use of barriers (i.e., synthetic membranes of clays) between the landfill and the area to be protected. With low-permeability systems, gases are not collected and therefore cannot be conveyed to a point of controlled release or treatment. The purpose of the system is to prevent or reduce gas migration into areas that are to be protected. These two concepts of passive gas control are often combined in the same system to provide controlled venting of gasses and blockage of available paths for gas migration.

Passive gas control systems can be used at virtually any site where there is capability to trench or drill and excavation to at least the same depth at the landfill. limiting factors could include the presence of a perched water table or rock strata. Passive vents would generally be expected to be less effective in areas of high rainfall or prolonged freezing temperatures. The depth of the trench is dictated by local site conditions. In general, the trench should extend from the ground surface to a relatively impermeable stratum of unfractured bedrock or clay or to the lowest groundwater table level. In some applications, the trench need not be as deep, so long as it extends to sufficient depth to intercept all possible avenues of gas migration. This depth is a function of the landfill depth and the geology in the vicinity of the landfill. The logistics of excavation open trenches can constrain the use of [passive] venting trenches to relatively shallow depths of 30 feet and less.

Passive gas control systems are essentially self-operating. Vent pipes, drainage patterns and general conditions in the vicinity of the systems should be occasionally inspected to identify the need for repairs or other maintenance. Monitoring the effectiveness of passive gas control systems normally consists of periodic sampling of subsurface gases from probes installed in the area being protected.

High permeability gas control systems have functioned adequately in mainly applications; however, there appear to be no clear patterns which dictate success or failure of the systems. While passive vents may perform effectively at some sites, the method cannot be considered to be reliable for gas migration control because of the inability of vents to control diffuse flow. Numerous passive well venting systems have been converted to active systems because of poor or unreliable performance. Low-permeability systems block diffuse flow and are highly reliable when properly designed and installed. Passive gas control systems can be implemented with relatively conventional construction equipment, labor, and materials. Handling and placement of synthetic liners requires specialized equipment and labor.

o Active Perimeter Gas Control Systems

Active perimeter gas control systems alter pressure gradients and paths of gas movement by mechanical means. These systems normally consist of (1) gas extraction wells, (2) gas collection headers and (3) vacuum blowers or compressors. In a typical system centrifugal blowers create vacuum through the collection headers and wells to the wastes and ground surrounding the wells. A pressure gradient is thereby established, inducing flow from the landfill to the blower. Subsurface gases flow in the direction of decreasing pressure gradient and are released directly to the atmosphere, treated and released, or, in some cases, recovered.

Active perimeter gas control systems can be used at virtually any site where there is capability to drill an excavation through landfilled material to the required depth. Limiting factors could include the presence of free-standing leachate or impenetrable materials within the landfill. Active systems are not sensitive to the freezing or saturation of surface or cover soils.

Gas extraction wells maybe installed either in refuse fill or in soil outside of the limit of fill. Wells normally consist of a drilled excavation 12 to 36 inches in diameter which is backfilled with one inch or larger crushed stone and 2- to 6-inch piping, which is perforated in the areas where gas is to be collected and solid in the upper portions. Solid-wall pipe is used and a concrete or clay seal is provided in the upper portion of the well to minimize infiltration of atmospheric air into the system. A valve is provided on the lateral connection of each well to allow regulation of flow and balancing of systems consisting of multiple wells. A monitoring port is provided for measuring velocity, pressure, and gas composition. Well spacing is a critical factor in the design of the system. Spacings on the order of 100 feet are commonly used, however, the appropriate spacing for a given site will depend upon the depth of the landfill, the magnitude of the vacuum applied to the well, and the rate of gas withdrawal.

Active gas control systems require testing and adjustment throughout their lives of operation. Initial start-up testing is required to ensure that all components are functioning as intended. Throttling of individual well valves and blower control valves is required to balance the system. Mechanical components require regular service such a lubrication and part replacement. In addition, subsurface gas probes in the area being afforded protection should be monitored at least annually after system start-up to ensure that gas migration is being controlled.

Differential settlement of the landfill material beneath header pipes can cause pipe movements resultant in adverse slopes, accumulation of condensate in low spots, and partial or complete blockage of gas flow. Proper pipe slopes an condensate drains can minimize this problem. A regular program of periodic inspection and maintenance should be established to identify pipe breakage, condensate blockage, or other header system failure.

o Active Interior Gas Collection/Recovery System

Active interior gas collection systems are similar to active perimeter systems except gas extraction wells are placed over the entire landfill surface. The design limitations and considerations are the same as perimeter systems except that spacing of wells is generally grater. Spacings of 200 feet are common. This technology has been applied or is under development for methane at over 50 sites worldwide.

Treatment Technologies

This section describes treatment methods applicable for treating aqueous, gaseous, and solid waste streams. Many of the methods described are widely used in industrial waste treatment applications and are well described in the literature.

o Aqueous Waste (pumped liquids)

Because of their potential diversity there are many treatment technologies that can be applied to aqueous waste streams. Rarely will any one treatment be sufficient so these techniques are usually used in combination. The most applicable treatment processes are (1) activated carbon treatment, (2) biological treatment, (3) filtration, (4) precipitation/ flocculation, (5) sedimentation technology, (6) ion exchange and sorptive resins, (7) reverse osmosis, (8) neutralization, (9) gravity separation, (10 air stripping, (11) oxidation, and (12) chemical reduction.

Activated carbon treatment is the process of adsorption onto activated carbon. It involves contacting a stream with the carbon, usually by flow through a series of packed bed reactors. The activated carbon selectively adsorbs constituents by a surface attraction phenomenon in which organic molecules are attracted to the internal pores of the carbon granules. Once the micropore surfaces are saturated with organics, the carbon is "spent" and must be either replaced or thermally regenerated. The time to reach "breakthrough" or exhaustion is the single most critical operating parameter.

Activated carbon is a well developed technology. It is especially well suited for removal of mixed organics from aqueous wastes. It is an effective and reliable means of removing low solubility organics. It is suitable for treating a wide range of organics over a broad concentration range.

Activated carbon is easily implemented into more complex treatment systems. The process is well suited to mobile treatment systems as well as on-site construction. Space requirements are small, start-up and shut-down are rapid, and there are numerous contractors who are experienced in operating mobile units.

The most obvious maintenance consideration associated with activated carbon treatment is the regeneration of spent carbon for reuse. Regeneration must be performed for each column at the conclusion of its bed-like so the spent carbon may be restored as close as possible to its original condition for reuse; otherwise, the carbon must be disposed.

Biological Treatment removes organic matter from the waste stream through microbial degradation. The most prevalent form of biological treatment is aerobic (i.e., requires oxygen). Specific processes that may be applicable include conventional activated sludge, pure oxygen activated sludge, extended aeration, contact stabilization, fixed film systems which include rotating biological discs and trickling filters.

There is considerable flexibility in biological treatment because of the variety of available processes and adaptability of the microorganisms themselves. Many organic chemical are considered biodegradable, although the relative ease of biodegradation varies widely.

Biological treatment has not been widely used in hazardous waste site remediation. Although the process can effectively treat a wide range of organics, it has several drawbacks for waste site application. The reliability of the process can be adversely affected by "shock" loads of toxics. Start-up time can be slow if the organisms need to be acclimated to the wastes and the detention time can be long for complex wastes. However, the existence of cultures which have been previously adapted to hazardous wastes an dramatically decrease start-up and detention time.

Loss of volatile organics from biological treatment processes can pose some localized air pollution and a health hazard to field personnel. Sludge produced in biological waste treatment may be a hazardous waste itself due to the sorption and concentration of toxic and hazardous compounds contained in the wastewater.

Filtration is a physical process whereby suspended solids are removed from solution by forcing the fluid through a porous medium. Granular media filtration is typically used for treating aqueous waste streams. The filter media consists of a bed of granular particles. The bed is contained within a basin and is supported by an underdrain system which allows the filtered liquid to be drawn off while retaining the filter media in place. As water laden with suspended solids passes through the bed of filter medium, the particles become trapped on top of and within the bed. In order to prevent plugging, the filter is backflushed at high velocity to dislodge the particles. The backwash water contains high concentrations of solids and requires further treatment.

Filtration is a reliable and effective means of removing low levels of solids for streams provided the content does not vary greatly and the filter is backwashed at appropriate intervals. Filtration equipment is relatively simple, readily available in a wide range of sizes and easy to operate and control. The significant maintenance consideration is handling the backwash. Backwash will generally contain high concentrations of contaminants and require subsequent treatment.

Precipitation is a physicochemical process whereby some or all of a substance in solution is transformed into a solid phase. It is based on alteration of the chemical equilibrium relationships affecting the solubility of inorganic species. Removal of metals as hydroxides or sulfides is the most common precipitation application in wastewater treatment. Generally, lime or sodium sulfide is added to the wastewater in a rapid mixing tank along with flocculating agents. The wastewater flows to a flocculation chamber in which adequate mixing and retention time is provide for agglomeration of precipitate particles. Agglomerated particles are separated from the liquid phase by settling in a sedimentation chamber, and/or by other physical processes such as filtration.

Flocculation is used to describe the process by which small, unsettleable particles suspended in a liquid medium are made to agglomerate into larger, more settleable particles. Chemicals used to cause flocculation include alum, lime, various iron salts, and organic flocculating agents called polyelectrolytes.

Once suspended particles have flocculated into larger particles, they usually an be removed from the liquid by sedimentation, provided that a sufficient density difference exists between the suspended matter and the liquid.

Precipitation is applicable to the removal of most metals from aqueous streams including zinc, cadmium, chromium, copper, fluoride, lead, manganese, and mercury. Also certain anionic species can be removed by precipitation, such as phosphate, sulfate, and fluoride.

Certain physical or chemical characteristics may limit the applicability of precipitation. Organic compounds may form organometallic complexes with metals, which could inhibit precipitation. Cyanide and other ions in the stream may also complex with metals, making treatment by precipitation less efficient. Highly viscous waste streams will inhibit settling of solids.

Precipitation and flocculation are well established technologies and the operating parameters are well defined. The processes require only chemical pumps, metering devices, and mixing and settling tanks. The equipment is readily available and easy to operate. Precipitation is nonselective in that compounds other than those targeted may be removed. Both precipitation and flocculation are nondestructive and generates a large volume of sludge which must be disposed.

Sedimentation is a process that relies upon gravity to remove suspended solids in an aqueous waste stream. The proces consists of a basin that will maintain the liquid in the quiescent state, a means of directing the liquid to the basin in a manner conducive to settling, and a means of physically removing the settled particles. This technology is applicable to the removal of particles heavier than water. Sedimentation provides a reliable means to remove suspended matter and is capable of 90 to 99 percent efficiency.

Ion Exchange is a process whereby the toxic ions are removed from the aqueous phase by being exchanged with relatively harmless ions held by the ion exchange material. Modern ion exchange resins are primarily synthetic organic materials containing ionic functional groups to which exchangeable ions are attached. These synthetic resins are structurally stable, exhibit a high exchange capacity, and can be tailored to show selectivity towards specific ions. The exchange reaction is reversible and concentration dependent, and it is possible to regenerate the exchange resins for reuse. Sorptive resins are also available for removal of organics and the removal mechanism is one of sorption rather than ion exchange.

Ion exchange can be used to remove a broad range of ionic species from water including: all metallic elements when present as a soluble species, inorganic anions, organic acids, and organic amines. Sorptive resins can remove a wide range of polar and non-polar organics.

Ion exchange is a well established technology for removal of heavy metals and hazardous anions from dilute solutions. Ion exchange can be expected to perform well for these applications when fed wastes of variable composition, provided the system's effluent is continually monitored to determine when resin bed exhaustion has occurred. Consideration must be given to disposal of contaminated ion exchange regeneration solution.

Reverse osmosis is the application of sufficient pressure to the concentrated solution to overcome the osmotic pressure and force the net flow of water through the membrane toward the dilute phase. This allows the concentration of solute to build up in a circulating system on one side of the membrane while relatively pure water is transported through the membrane. Ions and small molecules in true solution can be separated from water by this technique.

Reverse osmosis is used to reduce the concentrations of dissolved solids, both organic and inorganic. In treatment of waste streams the use of this process would be primarily limited to polishing low flow streams containing highly toxic contaminants. Good removal can be expected for high molecular weight organics and charged anions and cations. Multivalent ions are treated more effectively than are univalent ions. Recent advance in membrane technology have made it possible to remove such low molecular weight organics as alcohols, ketones, amines, and aldehydes.

Reverse osmosis is an effective treatment technology for removal of dissolved solids presuming appropriate pretreatment has been performed for suspended solids removal, pH adjustments, and removal of oxidizers, oil, and grease. Because the process is so susceptible to fouling and plugging, on-line monitors may be required to monitor pH, suspended solids, etc. on a continuous basis. Reverse osmosis has not been widely used for treatment of hazardous waste streams.

Reverse osmosis will not reliably treat wastes with a high organic content, as the membrane may dissolve in the waste. Lower levels of organic compounds may also be detrimental to the unit's reliability, as biological growth may form on a membrane fed an influent containing biodegradable organics.

Neutralization consists of adding acid or base to a waste in order to adjust its pH. The most common system for neutralizing acidic or basic waste streams utilizes a multiple compartmental basin usually constructed of concrete. This basin is lined with acid brick or coated with a material resistant to the expected environment.

Neutralization can be applied to any wastewater requiring pH control. It is a relatively simple unit treatment process which can be performed using readily available equipment. Only storage and reaction tanks with accessory agitators and delivery systems are required. Because of the corrosivity of the wastes and treatment reagents, appropriate materials of construction are needed to provide a reasonable service-life for equipment. The process is reliable provided pH monitoring units are used.

Neutralization of wastestreams has the potential of producing air emissions. Acidification of streams containing certain salts, such as sulfide, will produce toxic gases. Feed tanks should be totally enclosed to prevent escape of acid fumes.

Adequate mixing should be provided to disperse the heat of reaction if wastes being treated are concentrated. The process should be controlled from a remote location.

Gravity Separation is a purely physical phenomenon in which the oil is permitted to separate from water in a conical tank. It offers a straightforward, effective means of phase separation provide the oil and water phases separate adequately within the residence time of the tank. Simple, readily available equipment can be used and operational requirements are minimal. Consideration must be given to the disposal of the extracted waste constituents collected.

Air Stripping is a mass transfer process in which volatile contaminants in water or soil are transferred to gas. Air stripping is frequently accomplished in a packed tower equipment with an air blower. The packed tower works on the principle of countercurrent flow. The water stream flows down through the packing while the air flows upward, and is exhausted through the top. Volatile, soluble components have an affinity for the gas phase and tend to leave the aqueous stream for the gas phase. In the cross-flow tower, water flows down through the packing as in the countercurrent packed column, however, the air is pulled across the water flow path by a fan. The coke tray aerator is a simple, low maintenance process requiring no blower. The water being treated is allowed to trickle through several layers of trays. This produces a large surface area for gas transfer. Diffused aeration stripping and induced draft stripping sue aeration basins similar to standard wastewater treatment aeration basins. Water flows through the basin from top to bottom or from one side to another with the air dispersed through diffusers at the bottom of the basin. The air-to-water ratio is significantly lower than in either the packed column or the cross-flow tower.

In recent years, air stripping has gained increasing use for the effective removal of volatile organics from aqueous wastestreams. It has been used most cost-effectively for treatment of low concentrations of volatiles or as a pretreatment step prior to activated carbon. The equipment for air stripping is relatively simple, start-up and shut-down can be accomplished quickly, and the modular design of packed towers makes air stripping well suited for waste site applications.

Oxidation or reduction-oxidation reactions are those in which the oxidation state of at least one reactant is raised while that of another is lowered. In chemical oxidation, the oxidation state of the treated compound is raised. Common commercially available oxidants include potassium permanganate, hydrogen peroxide, calcium or sodium hypochlorite and chlorine gas. Chemical oxidation is used primarily for detoxification of cyanide and for treatment of dilute wastestreams containing oxidizable organics. Among the organics for which this treatment has been reported are aldehyde, mercaptans, phenols, benzidine, unsaturated acids and certain pesticides.

Chemical reduction involves the addition of reducing agent which lowers the oxidation of a substance in order to reduce toxicity or solubility or to transform it to a form which can be more easily handled. See the earlier discussion of in-situ chemical treatment processes which includes chemical reduction for more technical details.

With respect to aqueous liquids commonly used reducing agents include sulfite salts, sulfur dioxide and the base metals (iron, aluminum and zinc). Chemical reduction is used primarily for reduction of hexavalent chromium, mercury and lead. Very simple equipment is required for chemical reduction. This includes storage vessels for the reducing agents and perhaps for the wastes, metering equipment for both streams, and contact vessels with agitators. Some instrumentation is required to determine the concentration and pH of the waste and the degree of completion of the reduction reaction. Chemical reduction is a well demonstrated technology for the treatment of lead, mercury, and chromium.

Solids

The treatment of solids involves their separation from slurries and their classification by grain size. The objective of separating solids is to attain two distinct waste streams: a liquid that can be treated for removal of dissolved and fine suspended contaminants; and a concentrated slurry that can be dewatered and treated.

Classification of particles according to grain size may be undertaken for one of two reasons. First, is that more efficient use can be made of equipment and land area by taking advantage of the differences in settling velocity of different sized particles. Second, there is recent evidence to suggest that classification by grain size is important in managing contaminated soils because of the apparent tendency of contaminants to adsorb preferentially onto fine-grained materials.

o Separation

Solids separation methods include sieves and screens, hydraulic and spiral classifiers, cyclones, settling basins and clarifiers. These are all well demonstrated technologies that are widely adapted in industrial processes and wastewater treatment.

Sieves or screens consist of bars, woven wire or perforated plate surfaces which retain particles of a desired size range while allowing smaller particles and the carrying liquid to pass through the openings in the screening surface. Types of sieves or screens include grizzlies, moving screens and fixed screens.

Hydraulic classifiers are commonly used to separate sand and gravel from slurries and classify them according to grain size. These units consist of elevated rectangular tanks with v-shaped bottoms to collect the material. Discharge valves which are located along the bottom of the tank are activated by motor-driven vanes that sense the level of solids as they accumulate. The principal of operation is simple. The slurry is introduced into the feed end of the tank. As the slurry flows to the opposite end, solids settle out according to particle size as a result of differences in settling velocity.

The spiral classifier consists of one or two long, rotating screws mounted on an incline within a rectangularly shaped tub. It is used primarily to wash adhering clay and silt from sand and gravel fractions. The screw conveys settled solids up an incline to be discharged through an opening at the top of the tub. Fines and materials of low specific gravity are separated from sand and gravel through agitation and the abrading and washing action of the screw, and are removed along with the wastewater overflow at the bottom of the tub.

Cyclones and hydroclones are separators in which solids that are heavier than water are separated by centrifugal force. A hydroclone consists of a cylindrical/conical shell with a tangential inlet for feed, an outlet for the overflow of slurry, and an outlet for the underflow of concentrated solids. Cyclones and hydrocyclones contain no moving parts. The slurry is fed to the unit with sufficient velocity to create a "vortex" action that forces the slurry into a spiral and, as the rapidly rotating liquid spins about the axis of the cone, it is forced to spiral inward and then out through a centrally located overflow outlet. Smaller-sized particles remain suspended in the liquid and are discharged through the overflow. Larger and heavier particles of solids are forced outward against the wall of the one by centrifugal force within the vortex. The solids spiral around the wall of the cyclone and exit through the apex at the bottom of the cone.

A settling basin is an impoundment, basin, clarifier, or other container that provides conditions conducive to allowing suspended particles to settle from a liquid by gravity or sedimentation. The slurry is introduced into the basin and settling of solids occurs as the slurry slowly flows across the length of the basin. Flow out the opposite end of the basin is reduced in its solids content.

Commonly used types of settling basins are impoundment basins, conventional clarifiers and high rate clarifiers. An impoundment basin is earthen impoundment of diked area that is lined in a manner that is appropriate for protecting underlying groundwater. They are used to remove particles in the size range of gravel down to fine silt of 10 to 20 microns with flocculants. Conventional clarifiers are rectangular or circular settling basins which are typically equipped with built-in solids collection and removal mechanisms. A high rate clarifier uses multiple "stacked" plates, tubes, or trays to increase the effective settling surface area of the clarifier and decrease the actual surface area needed to effect settling.

Sedimentation employing impoundment basins are conventional clarifiers is a well established technology for removing particles ranging in size from gravel down to fine silt. Proper flocculation is essential to ensure removal of silt-sized particles. Sedimentation methods have not been widely employed for classifying solids according to particle size. They can be expected to be less effective in classifying solids than classifiers, cyclones, and screens.

o Dewatering

Dewatering is a physical unit operation used to reduce the moisture content of slurries or sludges in order to facilitate handling and prepare the materials for final treatment or disposal. Device which can be used to dewater materials include gravity thickeners, centrifuges, filters, and dewatering lagoons.

Gravity thickening is generally accomplished in a circular tank, similar in design to a conventional clarifier. The slurry enters the thickener through a center feedwell designed to dissipate the velocity and stabilize the density currents of the incoming stream. The feed sludge is allowed to thicken and compact by gravity settling. A sludge blanket is maintained on the bottom to help concentrate the sludge. The clarified liquid overflows the tank and the underflow solids are raked to the center of the tank and withdrawn by gravity discharge or pumping. Flocculants are often added to the feed stream to enhance agglomeration of the solids and promote quicker or more effective settling.

Gravity thickeners are used to concentrate slurries and are capable of achieving a solids concentration of approximately 2 to 15 percent. They generally produce the thinnest and least concentrated sludge of all the dewatering methods. The intent in using a gravity thickener is usually to reduce the hydraulic load of a slurry that is to be fed to a more efficient dewatering method. Gravity thickening provides a simple, low maintenance method for concentrating slurries, thereby reducing the hydraulic load to subsequent dewatering processes. They are suitable for operations where a high degree of operator supervision cannot be provided.

Dewatering lagoons use a gravity or vacuum assisted underdrainage system to remove water. The base of the lagoon is lined with clay plus a synthetic liner or other appropriate liner material to prevent migration of contaminants into the underlying soils and groundwater. At a minimum, the liner consists of a low permeability clay layer which is several feet thick. When the lagoon is no longer in use, the clay liner is excavated and properly disposed.

Dewatering lagoons are best suited to large-scale dewatering operations where the volume of sludge or sediment would require an inordinately large number of mechanical dewatering units. Lagoons are one of the more effective dewatering methods. A gravity dewatering system is capable of achieving 99 percent solids removal and dewatered cake of 35 to 40 percent solids after 10 to 15 days. The major limitations on the use of dewatering lagoons is that they require large land areas and long set-up times. Because of their large surface area they may not be well suited to areas with heavy rainfall or to areas where long periods of freezing would prevent dewatering.

Centrifugal dewatering is a process which uses the force developed by fast rotation of a cylindrical drum or bowl to separate solids and liquids by density differences under the influence of centrifugal force. Dewatering is usually accomplished using solid bowl or basket centrifuges. Disk centrifuges are also available and are mainly used for clarification and thickening.

Centrifuges can be used to concentrate or dewater soils ranging in size from fine gravel down to silt. Effectiveness of centrifugation depends upon the particle sizes and shapes, and the solids concentration among other factors. Data from the dewatering of municipal sludges indicate that solids concentrations ranging from about 15 to 40 percent are achievable with the solid bowl centrifuge. Solids capture typically ranges from about 85 to 97 percent with chemical conditioning.

Filtration is a physical process whereby particles suspended in a fluid are separated from it by forcing the fluid through a porous medium. Three types of filtration are commonly used for dewatering: belt press filtration, vacuum filtration, and pressure filtration.

Belt filter presses employ single or double moving belts to continuously dewater sludges. The sludge usually after some conditioning contacts the moving belt(s). The space containing the sludge is gradually decreased as the sludge moves through the process. Progressively more and more water is expelled throughout the process until the end where the cake is discharged.

A vacuum filter consists of a horizontal cylindrical drum which rotates partially submerged in a vat of sludge. The drum is covered with a continuous belt of fabric or wire mesh. A vacuum is applied to the inside of the drum. The wet solids adhere to the outer surface. As the drum continues to rotate, it passes from the cake forming zone to a drying zone, and finally to a cake discharge zone where the sludge cake is removed from the media.